



BOOK OF ABSTRACTS

M. Tech. (2005-2020)



**College of Food Processing Technology and Bio Energy
Anand Agricultural University, Anand 388110
Volume 1, March 2021**

BOOK OF ABSTRACTS

M. Tech. (2005-2020)

Compiled by:

Dr. S. H. Akbari
Dr. Bhaumik Patel
Er. Tanmay Bhatt
Dr. Hetal Bhatt



College of Food Processing Technology and Bio Energy
Anand Agricultural University, Anand 388110

Volume 1, March 2021

BOOK OF ABSTRACTS

M. Tech. (2005-2020)

- Volume** : 1
- Edition** : 2021
- Copies** : 300
- Compiled by** : Dr. S. H. Akbari, Dr. Bhaumik Patel, Er. Tanmay Bhatt and Dr. Hetal Bhatt
- Publication No.** : EDU-6:42:2020:300
- Publisher** : College of Food Processing Technology and Bio Energy
Anand Agricultural University,
Anand 388110,
GUJARAT
Phone/Fax : 02692-261302
e-mail : deanfpt@aau.in
Website : www.aau.in
- Printed by** : Asian Printery
Near Talati Hall,
Raipur Gate,
Raipur, Ahmedabad 380001
GUJARAT
Phone/Fax : 079-22148826



Dr. R. F. Sutar

Principal & Dean
College of FPT&BE
Anand Agricultural University
Anand - 388 110
Email : deanfpt@aau.in

Message

The processing of agricultural produce is as important as its production. The food processing technology is vital in view of increasing the economic return to the farmers, producing good quality processed products for nutritional security etc. in addition to reducing the post harvest losses. In view of above, PG (M.Tech.) students of College of Food Processing Technology and Bio-energy have carried out the research work in the area of Food Processing Technology with the help of teachers and scientists of the college.

The abstracts of M.Tech. theses of the last 15 years (2005 – 2020) have been compiled and published in this book. The research efforts were concentrated on the processing and value addition of agricultural produce. Different topics of food safety, food quality, food processing, energy audit, value addition, storage, development of methodology, development of machine, economic feasibility and modeling etc. are covered.

I congratulate the team of teachers and scientists of Department of Post Harvest Engineering and Technology, for their efforts on bringing out this valuable publication and I am sure, this publication will be useful to the research workers, entrepreneurs, food processors and farmers engaged in the field of Food Processing Technology.

(R. F. Sutar)

CONTENT

S. No.	Particulars	Page No.
1.	Food Processing Technology	1
2.	Food Process Engineering	101
3.	Food Safety and Quality Assurance	106



Ameer Ravani
(2005-2007)

STANDARDIZATION OF PROCESSING PARAMETERS FOR THE PRODUCTION OF READY-TO-SERVE UNRIPE MANGO BEVERAGE (PANA)



Dr. D. C. Joshi

Abstract

Unripe mango beverage (Pana) is a very popular traditional product prepared and consumed in most households in India as a preventive and curative remedy for sunstroke, bilious, gastro-intestinal and blood disorders. Traditional technology is slow, labour intensive, at times unhygienic and results in non-uniform quality of product. The present investigation was undertaken to standardize the processing parameters for the production of ready-to-serve unripe mango beverage. The effects of mango fruit variety (*Rajapuri*, *Langra*, *Kesar* and *Dashehari*); different methods and conditions of cooking fruit (boiling in water at 100°C for 15, 20, 25 and 30 min; pressure cooking at $68.96 \times 10^3 \text{ N/m}^2$ for 10, 15, 20 and 25 min; steaming at $68.96 \times 10^3 \text{ N/m}^2$ for 10, 15, 20 and 25 min; and baking at 200°C and 300°C for 20, 25 and 30 min); additives (sugar: 6.00, 7.12 and 8.00%; salt: 0.40, 0.56 and 0.60%); rate of dilution of pulp concentrate (1:5, 1:6, 1:7 and 1:8); and thermal processing (at $75 \pm 2^\circ\text{C}$ for 5, 10 and 15 min) for preservation with / without preservative were evaluated in detail with respect to the physical, chemical, microbiological and organoleptic quality of the final product. The above parameters were optimized for the maximum yield of most superior quality RTS beverage. The unripe mango RTS beverage prepared from *Langra* fruits pressure cooked at for 10 min, peeled, pulped, diluted with 8 times water, and spiced with 0.56% salt and 8.00% sugar was found to be highly acceptable. The diluted product when thermally processed at $75 \pm 2^\circ\text{C}$ for 15 min and added with sodium benzoate @ 100 ppm could be safely stored for at least one month under refrigerated condition. The optimized technology for the production of ready-to-serve unripe mango beverage has been suggested for large scale trials and mechanization.



Nandkishor Patil
(2005-2008)

STUDIES ON PRECOOLING OF MANGO (*MANGIFERA INDICA*) CV NEELAM FOR EXTENSION OF SHELF-LIFE



Dr. R. F. Sutar

Abstract

The present investigation entitled “Studies On Precooling of mango (*mangifera indica*) cv neelam for extension of shelf-life” was conducted with three precooling methods and three storage temperature, with three replications in Completely Randomized Design. The mango fruit cv. Neelam was precooled by dipping in chilled water, hydrocooling and forced air cooling. After precooling mango fruit were stored in cold store (13°C at 85 to 90% humidity), evaporative cooled storage and at room temperature. For precooling, the dipping method took the least time of 26 and 31 min followed by hydrocooling which took 38 and 45 min and forced air cooling which took 97 and 105 min at precooling temperature of 5 and 8°C. The study revealed that precooling with dipping chilled water was the fastest method for reducing the temperature by removal of filled heat from fruit followed by hydrocooling and forced air precooling. It was found that there was an increase in TSS with corresponding decrease in acidity upon prolonged storage of mango fruit irrespective of treatments. Physiological loss in weight and spoilage increased during storage period in all the treatments. The fruit precooled by dipping chilled water at 5°C showed lowest physic-chemical changes followed by hydrocooling and forced air cooling. The physic-chemical changes were slower in fruit stored at cold storage followed by evaporative and cold storage. In unprecooled fruit stored at cold storage, the rates of physic-chemical changes were low as compared to evaporative and room storage. The shelf life of the unprecooled fruits stored at cold storage was found 26 days followed by 13 and 10 days in evaporative and ambient storage respectively. The highest shelf life of 36 days was found in fruits precooled by dipping chilled water and stored at cold storage. Whereas the shelf life of 34 days and 32 days was found in hydrocooling and forces air cooling stored at cold storage. In evaporative storage, highest shelf life of 18 days recorded by dipping chilled water followed by 17 and 15 days in hydrocooling and forced air cooling respectively. Whereas ambient chilled water and hydrocooling respectively, followed by 11 days in forced air cooling.



Govind Tagalpallewar
(2005-2008)

STUDIES OF SODIUM CASEINATE AS AN EDIBLE COATING MATERIAL ON SHELF LIFE OF TOMATO FRUIT



Dr. R. F. Sutar

Abstract

Practice of packaging foodstuff with an edible coating is nature's way of protecting certain foods. The protective functions served by the edible protein film include oxygen, moisture barrier, control of flavor and other volatile migration, and prevention or control of photo degradation viz. oxidation. Milk proteins were shown to have better barrier properties to mass transfer at high relative humidity than starch or vegetable proteins. In addition to their nutritional value, milk proteins, such as casein, have several key physical characteristics for effective performance in edible films, such as their solubility in water and ability to act as emulsifiers. Caseinate films are attractive for use on food products because of their transparent, flexible and bland nature. They are already used for coatings of fruits, vegetables and cheese, as well as in food packaging. Sodium caseinate has a desirable flavor and shows excellent water-holding property. Fruits and vegetables are amongst most important foods of mankind as they are not only nutritive but are also indispensable for maintenance of health. The tomato is important because of its attractive red color, flavor, taste and nutritive value. Edible coating will also enable direct consumption such as in salad. The present investigation was undertaken to study the effect of sodium caseinate as edible coating on the shelf life and quality of tomato. The effect of different coating concentrations; different coating methods (spraying, dipping); and different storage conditions (room storage, cold storage at $13\pm 1^{\circ}\text{C}$) were evaluated in detail with respect to the chemical, physical and sensory quality of the tomato fruit. The tomatoes were stored up to 27 days at both room as well as cold storage conditions. The stored sample were analyzed after every three day interval for chemical properties (total soluble solids, titratable acidity, lycopene content, reducing sugar, ascorbic acid content); physical properties (physiological loss in weight, decay percentage, firmness); and sensory attributes (organoleptic taste, color, softness, degree of ripeness). The ripening of tomato was judged on the basis of tomato color, degree of ripeness and softness. The shelf life was found out on the basis of stage of ripening, PLW, decay and the quality of tomato fruits. The physical property of firmness and its corresponding sensory property of softness indicate that the firmness is better preserved in coated tomato under cold storage whereas softness is less in coated tomato under room condition. Titratable acidity and ascorbic acid values are higher for coated tomato stored under cold storage. The titratable acidity value of up to 0.50 was obtained by coated tomato under cold storage after 18 days whereas the same values under room conditions for both coated and control tomato fruits were obtained after only 9 days. Similar trends are also observed for degree of ripeness and organoleptic taste. Physiological loss in weight (PLW) is another parameter which confirms that the cold storage condition is better suited for storage of tomato. The coating concentration of 30 % sodium caseinate and coating by dipping method was found better based on the values of chemical, physical and sensory qualities. The increase in shelf life of 3 days was observed for coated tomato fruit under room storage and 9 days under cold storage condition compared to control.



Rahul Pawshe
(2005-2009)

DEVELOPMENT OF TECHNOLOGY FOR FIBER ENRICHED BREAD PREPARATION USING PIGEON PEA HUSK



Dr. K. B. Kamaliya

Abstract

The present study entitled “Development of Technology for Fiber Enriched Bread Preparation Using Pigeon Pea (*Cajanus cajan*) Husk” was proposed to be undertaken. The commercial bread formula (straight dough method) was modified and the manufacturing process was standardized to develop the therapeutic bread containing high amount of dietary fiber in the form of pigeon pea husk. A factorial completely randomized design was followed with three independent factors viz. (i) different pigeon pea husk levels (0, 2, 4, 6, 8 and 10%), (ii) different yeast quantity (1 and 1.25%) and (iii) different baking temperatures (210 and 220°C) with three replications. The physical, physico-chemical and nutritional characteristics of the raw material and the selected finished product were evaluated. Sensory evaluation was conducted to check the acceptability of the experimental bread. Refined wheat flour was replaced with different levels of pigeon pea husk at 2 to 10% in the standardized bread formula and physico-chemical as well as rheological properties were analyzed in 3 replications. Pigeon pea husk as dietary fiber possessed negligible content of wet and dry gluten whereas refined wheat flour contained similar value as per previous reports. The sedimentation value for both pigeon pea husk and refined wheat flour were found more or less similar. The alkaline water retention capacity found four times significantly higher (270%) in pigeon pea husk than refined wheat flour, which do corroborate with previous reports. The value of dough supplemented with pigeon pea husk showed increasing order in both the resistance to extension and the extensibility. Variation in yeast quantity did not have any effect on the resistance to extension and extensibility characteristics of the dough. Optimum level of 6% pigeon pea husk supplementation exhibited satisfactory crumb color, grain as well as taste and aroma characteristics in all the four treatments. Among all the treatments the breads prepared up to 6% pigeon pea husk supplementation found overall acceptable. An attempt of further addition of pigeon pea husk resulted in drastic decrease in the acceptability of the product. It was also observed that the control and 2% pigeon pea husk supplemented bread did not significantly differ from each other among all the four treatments. The major raw ingredients as well as control bread and developed bread which was found acceptable up to maximum incorporation of pigeon pea husk (i.e. 6%) were analyzed for proximate nutrients including fiber using standard methods of analyses. The moisture content of experimental breads varied between 42.03 to 42.13%. The breads prepared with pigeon pea husk supplementation had the lower carbohydrate content as compared to the control bread. The fiber content of pigeon pea husk was significantly greater (85.89%) than that of the refined wheat flour (0.34%). One serving (4 to 5 slices about 100gm) of bread as breakfast could able to supply 1/6th of the total Recommended Dietary Allowance of fiber for an adult.



Mansukhlal Parmar
(2006-2009)

STUDY ON DRYING CHARACTERISTICS OF BASIL LEAVES



Dr. S. S. Kapdi

Abstract

Basil is popular aromatic and annual herb growing in many region of the world. Immediately after harvesting, this highly perishable raw material has to be preserved against deterioration and spoilage. During peak period, most of the crop is lost/ wasted due to lack of proper post-harvest processing techniques. The fresh green leaves if properly dried, packed and stored may help in increasing its availability during lean periods. Drying is by far the most widely used treatment, but performed carefully so as to preserve the aroma and color of the raw material as much as possible. Various drying treatment and experimental methods viz., solar drying, tray drying, vacuum drying and fluidized bed drying were carried out at the 45, 55 and 65° C temperature to suggest the optimum drying condition for getting good quality dried basil leaves. The drying characteristics were plotted for different methods and treatments considered for the study. Effect of independent variable namely, the drying air temperature, pretreatment and dryers and quality parameters in the terms of chlorophyll, volatile oil, pH of basil leaves were studied. The active ingredient eugenol and caryophellene were also investigated for retention at 45, 55 and 65°C for blanched samples. The total drying time considerably reduced with increase in drying air temperature from 45 to 65°C. The whole drying takes place in falling period only. Chlorophyll and volatile oil decreased with increase in temperature from time 45 to 65°C. The storage behavior of the selected sample was studied for a period of 60 days for retention of biochemical contents and active ingredients. It could be recommended that drying of basil leaves should be carried out in the fluidized bed dryer at 45°C temperature for 30 seconds steam blanched sample to get the best quality of basil leaves as compared to other methods and treatments considered during the study.



Amit Singh
(2006-2009)

ENERGY CONSERVATION IN CHOCOLATE PLANT



Dr. S. S. Kapdi

Abstract

Study was, conducted for energy analysis of engineering services at the chocolate manufacturing plant during January to June, 2008. During the study, preliminary energy audit was done by carrying out primary visit to the plant and collection of the past bills available with the plant. The detailed energy was carried out in chocolate manufacturing plant in which the energy consumed by the unit processes were determined and the energy consuming device was tested for its performance. The total energy consumed in mixing process was 20 hp, refining process was 60 hp, conching process was 147 hp, tempering process was 21.5 hp, moulding process was 20.34 hp and packaging process was 7 hp. The performance evaluation of boiler was done and it was revealed that the boiler was working at the efficiency of 84.77 % and the cost of generating 1 kg of steam was Rs. 1.90. The refrigerating units were tested for their performance. The co-efficient of performance of chiller unit, packaging room refrigerating unit and the cold room refrigerating unit were found to be 5.12, 3.26 and 2.86 respectively. The illuminance level of the process section, packaging section and the sifting section were determined. The ILER of the process section during the day and night time operations are 7.05 and 0.52. The ILER of packaging section and sifting section for the day and night time operations were found to be 0.56, 0.47, 0.67 and 0.68 respectively. The co-relationship was developed by monitoring the electricity consumption and the product output for the predefined period of time. The specific energy consumption for producing 100 kg of chocolates was determined. The possible suggestions for conserving energy are made and the reduction in specific energy consumption would be obtained if the suggestions are accepted and implemented. It had been estimated that the specific energy consumption of the chocolate manufacturing plant would reduce to 38.23 kWh/100kg from the present 47.36 kWh/100kg.



Helly Contractor
(2007-2009)

FREEZE DRYING CHARACTERISTIC OF AONLA



Dr. D. C. Joshi

Abstract

The present investigation entitled “Freeze Drying Characteristics of Aonla” was conducted with a broad objective of developing freeze drying technology for aonla fruits. To do so the effects of various freeze drying variables such as material thickness, freezing temperature, freezing rate and heating temperature on the total time of freeze drying, moisture content, vitamin C retention and rehydration ratio of the freeze dried slices were evaluated. Two material thicknesses (2 and 4 mm), three freezing temperatures (-20, -30 and -40°C), freezing rates (0.6, 0.7 and 0.8°C/min) and heating temperatures (30, 40 and 50°C) were investigated. Significant effect was seen of the above variables on the quality of the final product. Total freeze drying time was the maximum (19 h) for the lowest freezing temperature and rate and the highest heating temperature and was the minimum (14.30 h) for the highest freezing temperature and rate and the lowest heating temperature. Moisture content of the dried product was the lowest for 50°C heating temperature and the highest for 30°C heating temperature. Similar results were seen for the rehydration ratio of the final product. Based on the above results, optimized values of the freeze drying variables obtained were; material thickness of 2 mm, freezing temperature of -20°C, freezing rate of 0.6°C/min and heating temperature of 30°C. The final product had 5.82% moisture, 91.7% vitamin C retention and rehydration ratio of 4.37. The optimized freeze dried slices were used to prepare aonla powder which was further used to prepare aonla squash. The aonla squash prepared from freeze dried powder was found to be at par with that made from fresh aonla and far superior to that made from hot air dried aonla.



Indrajit Thorat
(2007-2009)

STUDIES ON VACUUM DRYING CHARACTERISTIC OF GINGER



Dr. S. S. Kapdi

Abstract

Ginger (*Zingiber Officinale* Roscoe) has vast scope of diversification for its application on commercial products such as ice-creams, pickles, beverages and use in bakery and confectionary. The ginger rhizome and the obtained extracts contain polyphenol compounds (gingerol), which have a high antioxidant activity. Specifically, 6-gingerol has been identified as anti-bacterial, anti-inflammatory, anti-oxidant, anti-tumor, anti-ulcer and many others. The major effects of drying process on ginger observed were reduction in gingerol content, an increase in terpene-hydrocarbons and the conversion of some mono-terpene alcohols to their corresponding acetates. The motivation for this research was to find a suitable method for dehydration and to extend ginger shelf life for long term preservation. Vacuum drying was found suitable for obtaining quality dried ginger. The advantage of vacuum drying is observed clearly when biochemical and physical properties of dried ginger studied. Vacuum drying of ginger slices was carried out at various drying temperatures (40, 50, 60, 65 °C) and vacuum pressures (550, 600, 650 and 700 mmHg) to monitor the drying kinetics and quality (in terms of 6-gingerol retention) of the dried product. In terms of drying kinetics, the drying temperature was found to have an effect on the moisture reduction of sample dried in vacuum dryer. However vacuum pressure seemed to have an obvious effect only at lower temperature values (40 and 50°C) but slight in the case of higher temperature values 60 and 65°C. The drying rate curves indicated that the vacuum drying of ginger took place in the falling rate period. It was hypothesized that diffusion is the controlling mechanism for moisture transfer from core to surface. Dehydrated product quality analysis was accomplished by measuring the 6-gingerol content using HPLC technique. The result showed fresh mature ginger rhizomes with 78.54±2% (wb) moisture content had 6-gingerol contents of 1.249±0.01% (db). In terms of quality of dried product, it was found that the 6-gingerol content in dried ginger decreases with increase in drying temperature. Hot air dried unpeeled ginger slices showed total 6-gingerol content of 0.556±0.02% (db). The vacuum drying at 50°C with vacuum pressure of 700 mmHg, yielded good results with 6-gingerol content of 0.683±0.03% (db) in powder obtained. The water activity of ginger powder sample was found as 0.432±0.001 at temperature 32.2°C. The average bulk density of packed ginger powder was found 0.5670±0.0126 g/ml. The value of flowability time of ginger powder obtained from vacuum drying was found to be 22.6±0.5 seconds. The tomato soup sample with vacuum dried ginger powder 0.6 g/liter juice got highest overall acceptability, while in case of ginger tea the 0.4% addition of vacuum dried ginger powder was suggested based on score obtained in sensory evaluation. The storage study of the ginger powder showed that change in 6-gingerol content of ginger powder stored at room temperature was dependent on storage period. 6-gingerol content in ginger powder was reduced from 6.83 mg/g (db) to 3.63 mg/g (db) after 90 days of storage period.



Ankita Trivedi
(2007-2010)

STUDIES ON STANDARDIZATION OF WHEATGRASS JUICE EXTRACTION PROCESS



Dr. R. F. Sutar

Abstract

The primary form of food is grass and it is a balanced food containing a broad spectrum of high quality vegetable nutrition. Wheatgrass (*Triticum aestivum*) refers to the young grass of the common wheat plant. As a food wheatgrass is very nourishing and restorative with such a complete range of nutrient. The wheatgrass juice is prepared and consumed in most households in India as a preventive and curative remedy for various kinds of diseases. The juicers available for extraction of wheatgrass juice are blender, centrifugal juicer and masticating (single screw) juicer. Very little review is available on the efficiency of three juice extraction in terms of juice yield, retention of essential nutrients like ascorbic acid, chlorophyll, antioxidants etc. Therefore, the present investigation was undertaken to standardize the extraction process of wheatgrass juice. Wheatgrass growing involved various unit operations like soaking of wheat seeds, growing in prepared trays (soil without nutrients), irrigation at regular time interval and cutting of wheatgrass. The maturity level of wheatgrass at the interval of 5, 7 and 9 days was evaluated on the basis of physico-chemical parameters. The values obtained for 7 days old wheatgrass was found to be higher as compared to wheatgrass of other ages. Further experiment action was restricted to 7 days old wheatgrass. The wheatgrass juice extracted using centrifugal juicer and masticating juicer having 3000 and 75 RPM respectively. The dilutions selected were 1:0 (undiluted), 1:1, 1:2 and 1:3 for related studies. The selected quality parameters were pH, TSS, chlorophyll, ascorbic acid and TAC for all experiments. The wheatgrass was initially subjected to steam blanching. The steam blanched wheatgrass juice showed lower nutritional values as compared to unblanched wheatgrass juice. Therefore, steam blanching was avoided in further experiments. The comparative study was undertaken to standardize the extraction process of wheatgrass juice. The values obtained for wheatgrass juice extracted using masticating juicer was found to be higher while the values obtained for wheatgrass juice extracted using centrifugal juicer were observed to be comparatively lower. The undiluted wheatgrass juice extracted using masticating juicer had shown higher qualitative values. Hence, the microbial analysis and storage studies were done using the same samples. Sensory evaluation was carried out using 9 point Hedonic scale. The wheatgrass juice prepared in laboratory using masticating (single screw) juicer was compared to sample of wheatgrass juice available from the market. The wheatgrass juice prepared in laboratory had shown higher values for overall acceptance. Hence, it is recommended that wheatgrass juice extracted using masticating juicer is highly nutritious in accordance with identified quality parameters.



Kunal Mistry
(2007-2009)

DEVELOPMENT OF HIGH PROTEIN OKARA BASED EXTRUDED SNACK FOOD



Dr. R. F. Sutar

Abstract

Okara or soy residue is a by-product of soymilk production process. It has been found that okara protein is generally of higher quality than that obtained from other soy products both in terms of the protein efficiency ratio and the essential amino acid to total amino acid ratio and hence, it may prove as a suitable ingredient for nutritional enrichment of cereal-based products. The present investigation entitled “Development of High Protein Okara Based Extruded Snack Food” was conducted with a dual purpose of utilizing the by-product okara, to obtain an extruded snack food having high protein content. The okara obtained after extraction of soymilk, was dried in hot air oven at 50, 60, 70 and 80°C and based on the analysis of various physico-chemical and sensory attributes, the drying temperature of 70°C was found to be optimum resulting in okara powder having 49.82 % (db) protein content within 13:07 h. The extruded product was prepared using corn meal along with okara powder, in a twin screw extruder. The effect of independent variables viz. 5-20% okara content, 10–25% feed moisture content, 90-120°C extrusion temperature and 200–500 rpm screw speed, was investigated for protein content, various physical, textural and sensory attributes of extruded product. The experiments were conducted based on the design of Central Composite Rotatable Design using Response Surface Methodology. Based on the results obtained for various responses, the optimization of independent variables was carried out. The extruded product obtained using 9.92% okara content, 10 % feed moisture content, 112.18°C extrusion temperature and 425 rpm screw speed, was found to be containing 14.67% (db) and 13.84% (db) protein content based on theoretical and actual conditions along with optimum physical, textural and sensory characteristics.



Hitendrasinh Padhiar
(2007-2010)

DEVELOPMENT OF LOW FAT BISCUIT USING FAT REPLACERS



Dr. K. B. Kamaliya

Abstract

The present investigation was undertaken to develop low fat biscuits. In the study fat (Shortening) was replaced with different levels of maltodextrin and whey protein concentrate (WPC) i.e. 40 to 70% (in multiple of 10%) of fat content. Five fat replacement ratios (i.e., 100:0, 75:25, 50:50, 25:75 and 0:100::MD:WPC) and control were taken within each fat replacement level. Three replications of biscuits were carried out for the analysis. The sensory attributes, physical and rheological properties of control and the developed biscuits were studied. The biscuit found sensorily the most acceptable was further analyzed for nutritional composition and storage study. Sensory and rheological analysis of the selected experimental biscuit as compared to control were carried out during storage study. The cost of both types of biscuits was calculated for industrial application. Sensory evaluation of biscuits indicate significant difference between crust color and surface character, crumb color and taste and aroma at all fat replacement levels. Among all the experimental biscuits, 50:50 fat replacement ratio at 70% fat replacement level scored the highest for the most of all sensory attributes. Therefore, this biscuit was considered for further study. The results obtained for physical characteristics indicate that, increase in WPC produced biscuits with higher thickness as compared to control, while increase in MD content resulted in increased width, spread ratio and spread factor. Rheological study of the biscuits indicate that all experimental biscuits were significantly differ to control for both characteristics at all replacement ratios while no significant difference was observed among themselves at any fat replacement level. High level of fat replacement increased both hardness and fracturability significantly in spite of addition of fat replacers. Experimental biscuit with 50:50 ratio scored lower among all which was second important result. Nutritional analysis indicates that selected biscuit is low fat biscuit since it contains $4.19 \pm 0.10\%$ fat which meets the standard for low fat food. The fat content was reduced by 68% while protein content was increased by 26.76%. Calculated energy for the developed low fat biscuit was 401.43 Kcal/100g which was more than required for the low calorie food as per the definition. Shelf life study of the biscuits reflected that, there was no significant difference between selected experimental and control biscuit at all the weeks. That means both samples are acceptable after one month storage period. Thus, the developed low fat biscuit could be beneficial to replace the normal biscuit for the persons suffering from various cardio vascular diseases mainly caused due to excess fat and to maintain normal health for healthy individual. The cost of selected biscuit was found 83.03 Rs./kg higher but, could be sold at premium price because of health benefits. Such biscuit produced by large scale industry could be marketed as a functional food. Such other health beneficial bakery products could be developed for the well being of the community.



Gauri Athawale
(2008-2010)

STANDARDIZATION OF PROCESS TECHNOLOGY FOR SIMULATED CHYAWANPRASH BAR



Dr. S. H. Akbari

Abstract

The present investigation entitled “Standardization of process technology for simulated chyawanprash bar” was conducted with a broad objective to prepare and standardize the process of making simulated chyawanprash bar. The effects of various parameters such as drying temperature, pectin concentration and thickness of the sheet on the ascorbic acid content, overall acceptability final yield and drying time of the simulated chyawanprash bar were evaluated. Maximum ascorbic acid and overall acceptability score obtained for SCB was considered to optimize the processing parameters during tray and vacuum drying to get optimum quality of SCB. Maximum ascorbic acid content found was 89.41 mg/100g when the sheet of 4 mm thickness having 0.5% pectin concentration was tray dried at 60°C. For this above mentioned parameters, yield obtained was 71.85% and the drying time required was 11.30 h and for the same overall acceptability score was 6.16. During vacuum drying, maximum ascorbic acid content found was 87.18 mg/100g. When the sheet of 4 mm thickness having 0.5% pectin concentration was dried at 60°C. For this processing parameters, yield obtained was 71.36% and the drying time required was 18.30 h and for the same overall acceptability score was 6.63. The microbial result for it was under safe level. Considering maximum overall acceptability score, during tray drying maximum overall acceptability was 7.80, in the sheet having thickness of 8 mm and 0.5% pectin concentration and was dried at 60°C. For this processing parameter, ascorbic acid found was 88.80 mg/100g, yield obtained was 74.29% and the drying time required for it was 19.30 h. But, during vacuum drying, maximum overall acceptability score found was 7.50, when the sheet of 6 mm thickness having 0.5% pectin concentration was dried at 60°C. Considering these parameters, ascorbic acid found was 86.87 mg/100g, yield obtained was 72.99% and the drying time required for it was 21.30 h. The microbial result for it was under safe level.



Shweta Wattamwar
(2008-2010)

APPRAISAL OF DIFFERENT DECOLORATION SYSTEMS FOR CLARIFIED BANANA FRUIT JUICE



Dr. D. C. Joshi

Abstract

The present investigation entitled "Appraisal of Different Decoloration Systems for Clarified Banana Fruit Juice." was conducted with a broad objective of developing decoloring system for clarified banana juice. To do so the effects of various decoloring variables such as type of adsorbent, adsorbent concentration, adsorption temperature and adsorption time on the color value, TSS, turbidity and pH of the treated clarified banana juice were evaluated. Two adsorbents (bentonite and powdered activated charcoal), with respective concentration (0.3, 0.5, 0.7 and 0.9; 0.3, 0.5, 0.7, 0.9, 1.5, 2.0, 3.0, 5.0, 7.0 and 9.0 %, respectively), three adsorption temperatures (30, 45 and 60°C) and two adsorption duration (30 and 60 min) were investigated. Bentonite had little effect in decoloration of clarified banana juice and other quality parameters. Significant effect was seen of the variables for powdered activated charcoal on the quality of the final product. Color value was the maximum (35.14) for the 9.0% concentration of powdered activated charcoal and at 60°C adsorption temperature and 60 min adsorption time and was the minimum (11.10) for the 0.3% concentration of powdered activated charcoal, 30°C temperature and 30 min adsorption time. The TSS was the lowest (12.4 °Brix) for 9.0% PAC concentration, 30°C adsorption temperature and adsorption time of 30 min. The turbidity was maximum (5.78 NTU) at 1.5% PAC concentration, at lowest adsorption temperature (30°C) and lowest adsorption time (30 min) but minimum (0.32 NTU) at 9.0% PAC concentration, 60°C adsorption temperature and 60 min adsorption duration. Based on the above results, optimized values of the decoloration variables obtained within the range of the parameters studied were; type of adsorbent: PAC, adsorbent concentration: 9.0%, adsorption temperature: 60°C and adsorption duration: 60 min. The final decolorated clarified banana juice had 35.14 color value, 12.8°Brix TSS, 0.76 NTU turbidity, 4.52 pH, 0.1% finable acidity and 4 mg/100g ascorbic acid.



Baker Fenn
(2008-2010)

DEVELOPMENT OF JUICE EXTRACTION PROCESS FOR AONLA FRUIT



Dr. D. C. Joshi

Abstract

The *aonla* fruits were given pre-treatment of blanching. After standardizing blanching, the fruits were shredded, weighed and then pulverized using pulverizer. These pulverized materials were then passed through various juice extraction machines like basket centrifuge, fruit pulper, screw type juice extractor and hydraulic press. The steam blanching of aonla fruits for 2 minutes resulted in more quantity of juice (i.e. 51% juice recovery) with higher ascorbic acid content (698 mg/100ml). The fruit after steam blanching for 2 minutes when pulverized gave higher juice recovery. The maximum juice recovery (76%) was given by screw type juice extractor compared to other juice extraction machines. The screw type juice extractor was operated at four different rotational speeds (90, 180, 270 and 360 rpm) and the juice recovery was noted for each speed. The maximum juice recovery (74%) was at 90 rpm. The ascorbic acid content was 729 mg/100ml, titratable acidity of the juice was 0.82% citric acid, pH of the juice was 2.8, total and reducing sugar content of fresh aonla juice from steam blanched fruit were 11.03 and 10.64% respectively and total soluble solids in juice was 17° Brix.



Saravanan M.
(2008-2010)

PRECOOLING OF AONLA FRUIT FOR SHELF LIFE ENHANCEMENT



Dr. R. F. Sutar

Abstract

The present investigation entitled “Precooling of aonla fruit for shelf life enhancement” was carried out to find out the effect of precooling and storage method for the extension of shelf life. The experiment was conducted in two phases. In the first phase, experiment was carried out with three precooling methods i.e., Hydrocooling, Forced air cooling and chilled water dipping at three precooling medium temperature (4, 6 and 8°C). The precooled samples were stored in three storage conditions i.e., Room temperature, Transport Condition and Cold Storage. In the second phase, the experiment was conducted with the best precooling method from the first phase and studied the effect of the chemical treatment (1% Calcium Nitrate Solution). The various parameters like physiological loss in weight (PLW), firmness, Percent spoilage, total Soluble Solids (TSS) and ascorbic acid content were compared. From the precooling experiment, the chilled water dipping method took the least time (4.5, 7.5 and 9 min at of 4, 6 and 8°C, respectively) followed by hydrocooling experiments and forced air cooling experiments at 4, 6 and 8°C which were 8, 21 and 30 min and 31.75, 44, 63.75 min respectively. The study revealed the precooling with chilled water dipping was the fastest method for rapid reduction of initial temperature of the fruit to the desired temperature. It was observed that firmness of aonla fruit decreased under ambient storage condition and increased under both transport condition and cold storage. The increase in Total Soluble Solids was observed in all the storage condition but it is maximum in ambient storage condition followed by transport storage and cold storage. The retention of ascorbic acid content is maximum in cold storage followed by transport condition and ambient storage. The maximum spoilage was observed in the ambient storage samples followed by transport storage and cold storage. The minimum physicochemical change was observed in cold storage samples including untreated samples followed by transport storage and ambient storage conditions. The maximum shelf life (35 days) was found in 8°C chilled water dipping in cold storage followed by transport condition (22 days) and ambient storage condition (12 days) followed by forced air cooling and hydrocooling. In control treatments, the maximum shelf life was found in 27 days in cold storage compared with 15 days in transport condition and 9 days in ambient storage. The maximum shelf life of aonla was found in the 8°C chilled water dipping with chemical treatment in cold storage (41 days) followed by transport condition (24 days) and ambient storage condition (12 days). In control with chemical treatment, the maximum shelf life was found to be 31 days in cold storage compared with 18 days in transport condition and 10 days in ambient storage. These results are also confirmed by bio-chemical analysis.



Manish Kothadia
(2008-2010)

EXTRACTION AND PRESERVATION OF BOTTLE GOURD JUICE



Dr. R. R. Gajera

Abstract

The present investigation entitled “Extraction and Preservation of Bottle Gourd Juice” was conducted to standardize the extraction and preservation method for production of bottle gourd juice. Juice obtained from unblanched shreds and hot water blanched shreds at 85°C for different time intervals like 2, 3 and 4 min. were characterized for sensory evaluation, a single time for blanching of bottle gourds shreds was optimized for juice extraction. The extraction of bottle gourd juice was done using centrifugal juicer without water and with water (2:1). Juice extracted from hot water blanched at 85°C for 2, 3 and 4 min. for preservation purpose. Juice was added with additives like 1% lemon juice, 1% ginger juice and 1% rock salt to enhance taste and flavor. Additives were added in juice before pasteurization and after pasteurization. After pasteurization juice was bottle filled, sealed, processed and kept for storage study. Juice samples stored at room temperature and at refrigerated temperature. The room temperature samples were analyzed after 3, 5, 7 and 10 days interval while refrigerated temperature sample were analyzed after 7, 14, 21 and 28 days interval. During storage, juice was analyzed for sensory evaluation, physic-chemical analysis and microbial analysis. During sensory evaluation, color, flavor, consistency and overall acceptability of juice were evaluated. The physic-chemical parameters evaluated were TSS, moisture content, titratable acidity, total sugar and ascorbic acid content for bottle gourd juice at mentioned time intervals. The microbial parameters evaluated by standard plate count, coliform count and yeast and mold count. The physic-chemical quality of juice was better in case of juice pasteurized at 85°C for 4 min and additives added after pasteurization in the juice during room as well as refrigerator temperature storage. The microbial quality of juice was better in case of juice pasteurized at 85°C for 4 min and additives added before pasteurization in the juice during room as well as refrigerator temperature storage. The shelf life of pasteurized bottle gourd juice was 5 days at room temperature and 7 days at refrigerator temperature.



Akshata Chhatre
(2009-2011)

SUPERCritical FLUID EXTRACTION OF VOLATILE OIL FROM BASIL LEAVES



Dr. R. V. Prasad

Abstract

The present investigation was undertaken to optimize supercritical fluid extraction parameters to obtain superior quality of Basil volatile oil. Basil leaves contained moisture content of $79.23 \pm 0.54\%$, ash of $1.7 \pm 0.37\%$, protein of $4.65 \pm 1.1\%$, carbohydrate of $6.99 \pm 1.5\%$, crude fat of $0.82 \pm 0.18\%$ and crude fiber of $6.2 \pm 0.13\%$. The effects of temperature (40, 45, 50, 55 and 60°C), pressure (100, 150, 200, 250 and 300 bar), dynamic time (20, 37.7, 55, 72.5 and 90 min) and particle size (0.4, 0.6, 0.8, 1.0 and 1.2 mm) were evaluated with respect to volatile oil yield and eugenol content in volatile oil. The optimization of supercritical fluid extraction was carried out by using central composite design. Optimized condition for SFE of basil volatile oil was 53.83°C temperature, 150 bar pressure, 0.83 mm particle size and 37.5 min dynamic time. Volatile oil extracted at optimized SFE condition had volatile oil yield of 1.1% and eugenol content of 436.04 mg/g. Volatile oil of basil obtained by SFE and hydro distillation were compared. It was observed that SFE provided shorter extraction time, higher volatile oil yield and higher percentage of active antioxidant ingredient that is eugenol. The basil volatile oil obtained by optimized SFE condition was stored at 37 and -18°C for the period of 90 days. Volatile oil stored at a temperature of 37°C showed decrease in eugenol content after 30 days. Changes in eugenol content of volatile oil stored at -18°C were less prominent and retained its quality for 75 days. Moderate decrease in eugenol noticed thereafter.



Divya Patel
(2009-2011)

DEVELOPMENT OF FERMENTED CEREAL-LEGUME BASED INSTANT FOOD (DHOKLA) USING MICROWAVE RADIATION



Dr. P. P. Sutar

Abstract

Fermented cereal-legume based instant food (Dhokla) is one of the popular indigenous fermented foods of India and eaten as snack item. The present investigation was carried out to optimize fermentation process, microwave vacuum drying process of optimized batter and microwave cooking of reconstituted Dhokla mix. Central composite design (CCD) was used to conduct experiments and optimization was carried out using response surface methodology (RSM) in all the processes. The effect of fermentation time (5.5-12.5 h), fermentation temperature (26.5-35.5°C), moisture content of batter (55-65% wb) and rice to bengal gram ratio (1.2-2.4) was evaluated with respect to total titrable acidity (TTA), total lactic count (TLC), firmness and overall acceptability scores (OAA) of steam cooked Dhokla. Optimized condition for fermentation process was TTA 0.64 g mL⁻¹, total lactic count 221.62 cfu g⁻¹, firmness 146.35 g and OAA score 6.82 at 12.5 h fermentation time, 26.5C temperature, 65% moisture content of batter and 1.2 rice to bengal gram ratio. Further, the optimized fermented batter was dried by microwave vacuum using different independent variables like thickness of batter (10-17 mm), microwave power density (3.5-10 Wg⁻¹) and pulsating ratio (1.3-2). The responses studied were bulk density, rehydration ratio, color difference (ΔE) and OAA score. The best combination was found with bulk density 1014.22 kgm⁻³, rehydration ratio 4.55, ΔE 9.57 and OAA score 6.88 at 17 mm thickness of batter, 10 Wg⁻¹ microwave power density and 1.3 pulsating ratio. The dehydrated Dhokla mix prepared at optimum drying conditions was cooked in domestic microwave oven with independent variables like microwave power density (1.8-3.1 Wg⁻¹), cooking time (6.4-10.6 min) and water (281-519 gg⁻¹ dry mix). The firmness and OAA scores of Dhokla were collected. Optimized product resulted into firmness 252.91 g and OAA 7.01 at 3.1 Wg⁻¹ microwave power density, 6.4 min coking time and 519 g water g⁻¹ dry mix. Page model was used to model drying kinetics. The drying rate constant (k) ranged from 0.015 to 0.064. The apparent diffusivity varied from 1.48×10^{-08} to 1.09×10^{-06} m² s⁻¹ for microwave vacuum drying of dehydrated Dhokla mix. Further, study of the sorption behavior of dehydrated Dhokla mix and shelf life prediction was carried out using Guggenheim, Anderson and deBoer (GAB) model to describe the water activity (a_w) - equilibrium moisture content (X) interactions. Shelf life of Dhokla mix was predicted as 278 days at 40°C temperature and 90% relative humidity.



Farah Vahora
(2009-2011)

DEVELOPMENT OF EXTRUDED SNACK PRODUCT USING AONLA (*EMBLICA OFFICINALIS*) POMACE



Dr. N. P. Sutar

Abstract

The present investigation was carried out to develop value added extruded food product for the utilization of aonla pomace. Incorporation of aonla pomace in the blend of corn, rice and bengal gram flour was carried out to obtain nutritious cereal-pulse based extruded product. Aonla fruit (var. Anand Aonla II) was selected for the production of aonla pomace to be used in the process. Two methods were studied for drying of pomace- Hot Air Drying (45-85°C) and Microwave Vacuum Drying (power density: 0.5-5 W/g). Microwave vacuum drying at 3.875 W/g power density and 80 kPa pressure was optimized for pomace. Dried pomace was milled and stored in air tight containers at room temperature. Experimental design contained corn flour (50–100g), pomace (2–30g), die temperature (80–175°C), screw speed (150–350 rpm) and total solids (75–91%) as independent variables. Different combinations were studied using ANOVA to investigate the effect of the variables on responses such as moisture content, expansion ratio, color change, hardness, fracturability, water absorption index, water solubility index, bulk density, apparent density and sensory parameters. Extrudates with 85.5g of corn flour and 21.8g of pomace extruded at 147°C die temperature and 292 rpm screw speed with total solids 86.7% had higher preference levels for overall acceptability of the product. Crude fiber of optimized extrudates was found to be 7.2±0.2%. Polynomial model for hot extrusion process were developed to correlate different independent and dependent variables. Study of the sorption behavior of extruded snacks and shelf life prediction was carried out using Guggenheim, Anderson and deBoer (GAB) model to describe the water activity (a_w) - equilibrium moisture content (X) relationship. Simultaneously laboratory storage studies were carried out for 45 days to validate the model. The results suggest that aonla pomace can be extruded with cereal-pulse blend into an acceptable and nutritional snack.



Pankaj Kulkarni
(2009-2011)

STANDARDIZATION OF TECHNIQUE FOR PRESERVATION OF AONLA JUICE



Dr. H. Pandey

Abstract

The present investigation entitled “Standardization of Technique for Preservation of Aonla Juice” was conducted with a broad aim of developing and standardizing the technology for preservation of aonla juice from Anand Aonla-II variety. Aonla fruits had average diameter of 38.80 ± 2.18 mm (vertical) and 33.28 ± 1.53 mm (horizontal). Average weight of whole fruit, pulp and seed were 31.80 ± 5.96 g, 28.21 ± 4.83 g and 2.48 ± 0.26 g respectively. Specific volume and specific gravity of the fruits were 29.50 ± 4.97 ml and 1.07 ± 0.06 respectively. Fresh aonla juice contained 120.95 mg/100ml of ascorbic acid with acidity of 2.34% and pH of 1.97. Total soluble solids, reducing and total sugars of the juice were found to be 12.7B, 7.6% and 7.9 % respectively. Tannin content of the fresh juice was higher (1.004%) which contributed to astringent taste of the juice. Microbial analysis of the fresh juice revealed that the total plate count, yeast and mould count and coliform count of the juice were 1×10^3 cfu/ml, 3.01×10^3 cfu/ml and zero respectively. The extracted juice was then chemically and thermally treated at various time (3-9 minutes) and temperature ($75-90^\circ\text{C}$) combinations. Benzoic acid (sodium benzoate) was used as chemical preservative at the concentration of 600 ppm. Optimized condition for processing of juice was 85°C for 3 minutes without addition of chemical preservative. Juice treated with optimized condition was having 97.14 mg/100ml ascorbic acid, 2.304% acidity, 1.97 pH, 13.98°B TSS, 9.5% reducing sugars, 10.96% total sugars and 1.004% tannins. The juice was processed at optimized time and temperature combination, hot filled in pre-sterilized glass bottles, crown corked and left in incubator, maintained at 37°C for storage study. Stored aonla juice was analyzed for physico-chemical, microbial and sensory properties after 15 days intervals for a period of 3 months. Ascorbic acid and tannins of the untreated and treated aonla juice decreased during storage while acidity, reducing and total sugars increased. TSS of both untreated and treated juice samples was constant throughout the storage period. Sensory score of the treated juice was decreased during storage. There was no typical trend was observed for microbial load during storage for both the treated and untreated juice samples. Total plate count of the untreated aonla juice sample increased initially upto 15 days of storage and decreasing trend was observed for remaining storage. For treated juice sample same trend was observed. Total plate count for untreated and treated juice sample was varied in the range $0-88 \times 10^3$ cfu/ml and $0-3 \times 10^3$ cfu/ml respectively. Yeast and mould count for the untreated aonla juice decreased in first 15 days of storage and then remained nearly same throughout the storage period ($0-3.01 \times 10^3$ cfu/ml). For treated juice sample, yeast and mould count slightly changed during storage ($0-10 \times 10^3$ cfu/ml). Coliform count of the untreated and treated was zero during entire storage period.



Nirav Joshi
(2009-2011)

TECHNOLOGY DEVELOPMENT FOR PRODUCTION OF READY-TO-EAT PUFFED RICE USING MICROWAVE ENERGY



Dr. D. Mohapatra

Abstract

Twelve varieties of rice were screened for the best puffing quality based on their chemical composition and physical characteristics such as amylose content, protein content, length, width, thickness, hardness, true density and bulk density. The data was analyzed using Pearson's correlation and a strong positive correlation was found to exist between amylose content and expansion ratio. At the same time protein content was found to be negatively related with amylose content, length expansion ratio and volume expansion ratio. From the analysis *GR-5*, *Gurjari* and *Jaya* varieties were selected for further puffing studies. Microwave aided puffing was carried out in a convective- microwave oven for different parboiled and milled rice samples (10-100g) at 14% moisture content (wb), oven preheating temperature of 200°C and 900W power level. A sample size of 50 g was chosen based on the volume expansion ratio, puffing yield and specific energy consumption. Puffing characteristics were studied on *Gurjari* variety of rice at 14% moisture content for different preheating temperatures (180, 200, 220°C), power levels (300, 600, 900W), and residence times (10-100s) from which the range of residence time was selected for the optimization study. Optimization of the process parameters was done using response surface methodology, for a Box-Behnken design at 3 levels for 5 parameters i.e. variety (*GR5*, *Gurjari*, *Jaya*), moisture content (12, 14, 16% wb), preheating temperature (180, 200, 220°C), power level (300,600, 900W), and residence time (50, 60, 70s). The optimized conditions were found to be 14%, 220C, 900W and 60 s for *Gurjari* variety. The second order polynomial (SOP) model was validated by conducting 3 trials at the optimized point and found to be agreeing with the predicted values. A comparative analysis was carried out between the conventional method of rice puffing and microwave aided puffing. The specific energy consumption was found to be 20 times higher in case of domestic convective-MW oven (52.68 MJ/kg), as compared to that obtained in a commercial rice puffing industry (1.96 MJ/kg), where heat supplied for puffing was through burning wood chips.



Krantidip Pawar
(2009-2011)

DESIGN AND DEVELOPMENT OF BANANA PEELING MACHINE



Dr. R. F. Sutar

Abstract

Banana peeling is the primary and most important operation in banana processing. Manual peeling is relatively slow operation and involves substantial labour when a large number of peeled bananas are desired, so power operated banana peeling machine was designed and developed, suitable for small scale processing unit. Musa Cavendish and Robusta varieties were selected for the study. Some physical and mechanical properties of two varieties of unripe banana fruit were determined. The properties like fruit mass, effective length, diameter of fruit (with peel and without peel), pulp to peel ratio, volume, bulk density, hardness of banana were determined. The average respective values of weight, effective length, bulk density, pulp to peel ratio were 93.74 g, 13.24 cm, 430.23 kg/m³, 1.53 for Musa Cavendish, and 149.18 g, 17.32 cm, 374.11 kg/m³, 1.57 for Robusta cultivar. The diameter of banana, thickness of peel and hardness of Musa Cavendish cultivar varied from 30.8 to 35.6 mm, 3.15 to 4.45 mm and 9.15 to 13.46 N, respectively as well as for Robusta cultivar 29.45 to 35.65 mm, 3.2 to 4.65 mm and 11.70 to 16.11 N, respectively. Banana peeling machine was designed and developed by combination of gripping, slitting and scrapping mechanisms. The operating capacity of machine was decided to be 100 kg/hr. The whole machine was divided into conveying unit, peeling unit and power transmission unit. The first being the main conveying unit in which main components were feeding channel, spiked conveying unit, horizontal conveying unit, guide rollers and frame. Peeling unit consist of slitting blade, scrapping blade, separation unit and pulp collection unit while power transmission unit consists of electric motor and power distribution assembly. The average operating capacity at speed ranges 35-50 rpm, 50-60 rpm, 60-70 rpm and 70-80 rpm were 91.39 kg/hr, 107.76 kg/hr, 109.65 kg/hr and 140.82 kg/hr, respectively. At speed ranges 35-50 rpm, 50-60 rpm, 60-70 rpm and 70-80 rpm the effective capacity was found 76.49 kg/hr, 84.62 kg/hr, 98.89 kg/hr and 114.36 kg/hr, respectively. The peeling efficiency of machine was increased from 76.19% to 93.18% as speed of conveying pulley increased up to 70 rpm, above 70 rpm the peeling efficiency of machine was decreased. Damage percent was found in between 6.81% to 23.8%. Damage percentage was 23.8% when machine operated at high speed 80 rpm. Average power to be required to run the machine, under no load condition was observed 598 W while average power required for operating peeling machine was 752 W. The power efficiency of machine was estimated to be 25.75% only because power required to run machine ideally was more.



Akshay Belsare
(2010-2012)

SUPERCritical FLUID EXTRACTION OF ESSENTIAL OILS FROM GINGER AND TURMERIC



Dr. R. V. Prasad

Abstract

Ginger and turmeric are the rhizomes of *Zingiber officinale* and *Curcuma longa* family and are used as important culinary ingredients. They are dietary components with antioxidant and anticarcinogenic properties used for various purposes in medicinal, pharmaceutical and ayurvedic industry. The present investigation was undertaken to optimize supercritical fluid extraction parameters to obtain superior quality of ginger/turmeric essential oil. The percent moisture, ash, protein, crude fat and crude fiber of fresh ginger rhizome was observed to be 88.5 ± 2 , 0.75 ± 0.031 , 2.36 ± 0.018 , 0.869 ± 0.028 and 2.78 ± 0.015 respectively similarly percent moisture, ash, protein, crude fiber and crude fat of fresh turmeric rhizome was observed to be 87.8 ± 2 , 0.8 ± 0.02 , 2.59 ± 0.02 , 2.69 ± 0.018 and 0.848 ± 0.015 respectively. The effects of temperature (35, 40, 45, 50 and 55°C), pressure (150, 200, 250, 300 and 350 bar), dynamic time (60, 90, 120, 150 and 180 min) and particle size (0.5, 0.75, 1.0, 1.25 and 1.50 mm) were evaluated with respect to ginger/turmeric oil yield and 6-gingerol/curcumin content in ginger and turmeric oil, respectively. The optimization of supercritical fluid extraction was carried out by using central composite design. Optimized condition for SFE of ginger oil was 40°C temperature, 300 bar pressure, 0.75 mm particle size and 150 min dynamic time. For turmeric oil, it was 50°C temperature, 300 bar pressure, 0.75 mm particle size and 150 min dynamic time. The yield of ginger oil in SFE at optimized condition was 3.78% and the 6-gingerol content was 20.13 mg/g similarly the yield of turmeric oil in SFE at optimized condition was 3.37% and curcumin content was 369.23 mg/g. Ginger and turmeric oil obtained by SFE and hydro distillation were compared. It was observed that SFE provided shorter extraction time, higher oil yield and higher percentage of active antioxidant ingredients. The ginger/turmeric oil obtained by optimized SFE condition were studied for their antimicrobial activity against four selective bacterial strains. Among these strains, extracts of ginger and turmeric had shown the highest antimicrobial activity against *E. coli* and moderate activity was observed against *Lactobacillus helveticus* and *Streptococcus thermophilus*. Antimicrobial activity was not observed against *Salmonella typhi*.



Dipali Jagtap
(2010-2012)

MICROWAVE VACUUM DRYING CHARACTERISTICS OF BANANA SLICES



Dr. D. C. Joshi

Abstract

The drying characteristics and quality of the banana slices processed with microwave vacuum drying method was investigated. The pre-drying treatments of blanching and osmotic dehydration were applied in order to evaluate their effects on quality of microwave vacuum dried banana slices. Also the effect of various microwave vacuum drying variables was studied. Dehydrated product quality in terms of the ascorbic acid content, percent shrinkage, rehydration capacity and texture properties was evaluated. For osmotic dehydration as pre-drying, three variables were used; slice thickness (4, 6 and 8 mm), sugar syrup concentration (45, 55 and 65 Brix) and dehydration time (30, 60 and 90 min). On increasing the sugar syrup concentration and dehydration time, the final moisture content in the slice reduced but solid gain increased. On increasing the slice thickness, both the moisture content and the solid gain increased. The optimum conditions for osmotic dehydration were 45° Brix for 4 mm slice thickness and 90 min osmotic dehydration time, which gave the minimum final moisture content and the minimum solid gain. For microwave vacuum drying, two variables such as microwave on/off time (6/24, 12/18 and 18/12 s) and vacuum pressure (400, 500 and 600 mmHg) were investigated for osmotically pre-dried banana slices. Significant effect was seen of the above variables on the quality of the final product. In terms of drying kinetics, microwave on/off time was found to have effect on the moisture reduction of sample dried in microwave vacuum dryer. However, vacuum pressure seemed to have an obvious effect only at 6/24 and 12/18 s microwave on/off time. The drying rate curves indicated that the microwave vacuum drying of banana slices took place in the falling rate period. The ascorbic acid content in dried banana slices decreased with the increase in microwave on/off time. The osmotically dehydrated banana slices with the 176.17% (db) moisture content had ascorbic acid content of 2.469% (db). Hot air dried banana slices showed total ascorbic acid content of only 0.572% (db). The microwave vacuum drying at 12/18 s microwave on/off time with vacuum pressure of 600 mmHg yielded product with high ascorbic acid content of 0.955% (db). The highest retention (38.665%) of ascorbic acid was observed at above drying condition. The microwave vacuum dried banana slices were also found organoleptically superior as compared to hot air dried samples. The change in ascorbic acid content of banana slices stored at room temperature was dependent on storage period. Ascorbic acid content in dried banana slices reduced from 0.955 to 0.624% (db) after 60 days of ambient storage.



Ankita Parmar
(2010-2012)

STUDIES ON PRODUCTION OF KAJUKATLI



Dr. A. K. Sharma

Abstract

Kajukatli is one of the nut based sweet manufactured and sold in large quantities in India. It is made on a small scale by the unorganized sectors of dairy industry, which generally adopt age-old methods. The product resembles to Burfi in many aspects. However, the scientific literature pertaining to this product is scanty so to make the scientific information available; the product is selected for the present study. Organized sector of dairy industry and other halwais (sweet maker) has realized the importance and profitability of such traditional product in Indian market. Hence, it is very much needed to make some research and development efforts to determine the inherent process parameters related to the formulation techniques and proper documentation incorporating the knowledge of science and technology in view of preparing standard quality product and get the opportunity in developing the market for Kajukatli. So, a survey as well as standardization and analysis were conducted on formulation techniques. Primary information were collected from Kajukatli producers i.e. dairy co-operatives and sweet-makers (halwais) etc. by observing Kajukatli preparation and interview method using pre- designed questionnaires. The cities of Anand, Ahmedabad, Surat and Vadodara (Baroda) were selected for the market survey. The samples from preparation sites and popular shops (coded as MS1, MS2, MS3, MS4, MS5, MS6 and MS7) were collected for evaluation of physicochemical, microbial, textural and sensory attributes. Standardization of process for the preparation of Kajukatli was done and subjected to physicochemical, microbial, textural and sensory characteristics analysis. Storage study for standardized sample was carried out at room temperature and refrigerated condition. In the market survey samples, kaju facia 50-70%, sugar 50-30% and water 20-25% were used for the preparation of Kajukatli. The fat content, protein content, moisture, FFA and sugar of market sample ranges from 21-27%, 19-22A, 6.4-8.4%, 1.28-1.52% and 25-35%, respectively. Hardness and stickiness were in the range of 33.18-374.10 N and 0.109-0.329 Nmm, respectively. For standardization of recipe of Kajukatli, kaju paste was observed best based on the sensory evaluation of the market samples as well as product prepared in the lab. The standardized process ingredients were found kaju paste 65% and sugar 35% of final product. The moisture content, fat, protein, sugar, ash, FFA (as percent oleic acid), water activity, hardness and stickiness was found 9.42%, 26.43%, 24.8%, 30.26%, 0.98%, 1.22%, 0.793%, 170.2 N and 2.23 Nmm. During storage study, fungal growth (mucor) was observed in the sample stored at room temperature after 10 days, while no spoilage was observed in refrigerated sample.



Mamta Patel
(2010-2012)

DEVELOPMENT OF BANANA-PAPAYA MIXED FRUIT BAR



Dr. D. C. Joshi

Abstract

Fruit bar is the product prepared by blending pulp from sound ripe fruit, nutritive sweeteners and other ingredients appropriate to the product and dehydrated to form sheet which can be cut to desired shape and size. The present investigation was carried out to optimize different ingredients and drying conditions for production of banana-papaya mixed fruit bar and its quality evaluation. Central composite design (CCD) was used to conduct experiments and optimization was carried out using response surface methodology (RSM). The effect of banana-papaya pulp ratio (0:100, 25:75, 50:50, 75:25 and 100:0), citric acid (0.3-1.0%), corn starch (1.0-5.0%) and pectin (0.2-0.6%) was evaluated with respect to overall acceptability scores (OAA), hardness, stickiness and ascorbic acid in dried mixed fruit bar. The best recipe was 25:75 of banana- papaya pulp ratio, 0.48% citric acid, 4% corn starch and 0.5% pectin. This resulted in a good product with OAA score 7.31, hardness 304.06 N, stickiness 1.57382 N.mm and ascorbic acid 34.10 mg/100g. Further, the standardization of drying temperature (60-80°C) for optimized recipe of banana-papaya mixed fruit bar was carried out using a tray dryer. The mixed fruit bar dried at 65°C was the most acceptable in sensory attributes, texture and ascorbic acid retention. Study of the sorption behavior of dried mixed fruit bar and shelf-life prediction was carried out. Shelf-life of optimized mixed fruit bar was predicted as 248 days and 164 days at 40°C and 90% relative humidity for bi-axially oriented polypropylene (BOPP) and polyester polyethylene laminate; respectively.



Payal Patel
(2010-2012)

PRESERVATION TECHNOLOGY FOR WHEATGRASS JUICE



Dr. R. F. Sutar

Abstract

Grass has been primary form of food, with broad spectrum of high quality vegetable nutrition. Wheatgrass refers to young grass of the wheat plant, *Triticum Aestivum*. The wheatgrass juice is very nutritious, and contains wide range of nutrients. The shelf life of the wheatgrass juice is very short, it is usually prepared fresh and consumed within 3-4 hours. Very less research has been carried out to increase the shelf life of wheatgrass juice. Therefore, the present investigation was undertaken to develop preservation technology for wheatgrass juice. The 7 days wheatgrass (variety: G-496) was used for extraction of juice, using masticating juicer. The extracted juice was subjected to thermal treatment, but wheatgrass juice get precipitated at 55°C, and hence thermal treatment is not feasible to be used as preservation technique. The wheatgrass juice was then subjected to non-thermal technique of ultrasonication, for preservation. The effect of processing was studied on the quality parameters like protein, ascorbic acid, TAC, chlorophyll, pH, acidity, and microbial properties of wheatgrass juice. The ultrasonication process was carried out at the amplitude level of 50, 60 and 70%, for 5 and 10 min, with ON and OFF time 5, 10, and 15 sec. The deterioration of wheatgrass juice usually take place in 3–4 hours, but to estimate the cause of spoilage, parameters like pH, acidity, ascorbic acid, TSS, and reducing sugar were analyzed hourly. The major determinate for spoilage of juice was pH, the pH of juice within 6 hours reduces from 6.35 to 5.8. The microbiological quality of wheatgrass juice greatly improves after ultrasonication process at refrigerated condition whereas; at the room temperature the microbial count increase rapidly and is unacceptable within 3 hours. The coliform counts were found to be minimum at 70 and 60% amplitude level in juice up to 7 days. The coliform growth increases in juice treated at 50% amplitude level both at room and refrigerated condition after 3 hours and 4 days respectively. The protein content, chlorophyll content, TAC and ascorbic acid were decrease from 27.18 to 17.05%, 69.06 to 44.30 mg/100ml, 427.96 to 264.29 mg/100ml, 10.56 to 4.5 mg/100ml from 0 to 10 days at refrigerated condition respectively. The pH of processed juice reduces from 6.4 to 4.99 at refrigerated condition within 10 days. The acidity and TSS was found 0.88% (citric acid) and 5.1, respectively at refrigerated condition after 10 days. The gas chromatographic analysis for flavor profile of juice at 70% amplitude level changes at slower rate compare to 60 and 50% amplitude level at refrigerated condition, similar attributes were observed during sensory evaluation. The overall acceptability of juice was found decreasing from 8 to 4 hedonic points from 0 to 7 days at refrigerated condition respectively. Thus from the studies it can concluded that the juice resulting from treatment combination T1, T3, T6, and T8 had acceptable shelf life of 5 days at refrigerated condition.



Tarang Patoliya
(2010-2012)

ENERGY AUDIT IN SNACK PROCESSING LINE



Dr. H. Pandey

Abstract

The present global scenario of energy crisis has forced food processing industry to become more energy conscious. With liberalization of industrial policy, the food processing industry is facing challenges both in terms of quality and plant performance. As operations performed in food processing plants especially in snack processing line are quite energy intensive, the check on energy usage is in priority concern. Engineering services in food plants is considered as the area where simple plant optimization measures can lead to substantial and almost immediate savings. In snack processing line, electricity was the main energy utilized for operation of machineries, such as prime movers and lighting while the thermal energy was used for frying of snacks. For any industry, a perfect energy audit being first step to identify and suggest the area of energy wastages and set realistic goals for achievable savings. During the study, preliminary energy audit was done by carrying out visits to the plant and collection of the past bills available with the plant. The detailed energy audit was carried out in snack processing line in which the energy consumed by the unit processes were determined and the energy consuming devices were tested for their performance. The total energy consumed in the chips line was 418.23 kWh per day whereas energy consumed by the crackers line was 551.96 kWh per day, respectively, inclusive of all unit operations. Thermic fluid heater was operated along with heat exchanger which utilizes the 9 SCM of PNG per hour. Energy delivered by the PNG was transferred to the frying oil with the help of heat exchanger having the overall heat transfer coefficient of 1.73 kJ/Km²hr. The frying oil gain only 10.61% of the total thermal energy derived from the direct burning of diesel at the rate of 1.53 lit/hr. The illuminance level of all the sections were determined and found to be good during day time while during night the ILER in some of the sections found to be poor and needed immediate action. The relationships were developed with electricity, diesel and PNG consumption and the product produced. The possible suggestions for conserving energy were made and the reduction in energy consumption would be obtained if the suggestions are accepted and implemented.



Viral Marathe
(2010-2013)

EVALUATION OF HEAVY METALS IN CANNED FOOD PRODUCTS



Dr. R. V. Prasad

Abstract

Heavy metals are toxic to human beings. They are present in trace amounts in food products but continuous consumption may lead to chronic diseases and they can neither be degraded nor be destroyed. The presence of heavy metals and its increase may be due to many factors like environmental pollutants, raw material movement, soil where it is grown, pesticides and fertilizers, processing equipments, packaging material, leaching of packaging material, chemical characteristics and many more. The present investigation entitled “Evaluation of heavy metals in canned food products” was conducted with a broad objective of surveying the presence of heavy metals in canned food products locally available in the Gujarat markets. Al, As, Sn, Pb and Cr are the heavy metals quantified from selected canned food products Rasogulla, Mango pulp, Corn, Pineapple slices, Cheese and Beverages. From each category, three brands were taken into consideration. Heavy metals were detected from different batches of canned food products during storage for period of 6 months. Acid digestion method was used for digestion of sample and AAS-GTA instrument was used for quantification of heavy metals. In present study, 108 samples were analyzed consisting in six categories and three brands consisting of 6 different batches in each brand. Mean values in canned Rasogulla, Mango pulp, Corn, Pineapple slices, Cheese and Beverages for Al are 3.195, 8.1343, 5.9214, 7.0347, 7.9971 and 9.0556 ppm, As 0.2050, 0.0611, 0.2300, 0.0663, 0.1078 and 0.0340 ppm, Sn 2.0783, 4.3152, 0.7010, 0.3530, 0.3640 and 0.9796 ppm, Pb 0.3831, 0.5575, 0.5220, 0.3238, 1.1356 and 0.6910 ppm and Cr 0.001, 0.1285, 0.0013, 0.1418, 0.4197 and 0.0014 ppm. Al was found in order Beverages > Mango pulp > Cheese > Pineapple slices > Rasogulla > Corn, As was found in order Rasogulla > Corn > Cheese > Pineapple slices > Mango pulp > Beverages, Sn was found in order Mango pulp > Rasogulla > Beverages > Corn > Cheese > Pineapple slices, Pb in order Cheese > Beverages > Mango pulp > Corn > Rasogulla > Pineapple slices and Cr in order Cheese > Pineapple slices > Mango pulp > Beverages > Corn > Rasogulla. During storage, in different categories; increase in Al, As, Sn, Pb and Cr contents in canned Rasogulla, Mango pulp, Corn, Pineapple slices, Cheese and Beverages varied from 20.31-73.27%, 17.45-293.47%, 59.94-1280.37%, 71.99-518.12, and 27.48-21592.30%. Arsenic content in 16.66% samples was above 0.1 ppm which is more than the maximum permissible limit of FSSAI. Similarly, Pb content in 16.66% samples was above 0.5 ppm which is more than the maximum permissible limit of FSSAI. In the profile of heavy metals in canned foods, Al was detected maximum in Beverages and minimum in Corn. Arsenic was detected maximum in Rasogulla and minimum in Beverages. Tin was detected maximum in Mango pulp and minimum Pineapple slices. Lead was detected highest in Cheese and lowest in Pineapple slices. Chromium was detected maximum in Cheese and minimum Rasogulla.



Ankur Bhavsar
(2011-2013)

PROCESS TECHNOLOGY FOR TOMATO AND CARROT POMACE BASED EXTRUDED PRODUCT



Dr. H. Pandey

Abstract

Tomato– Carrot pomace incorporation in corn flour (*Gujarat Makai -3*) and bengal gram flour (*Gujarat Gram -2*) was carried out to obtain nutritious cereal pulse blend for extrusion cooking. Carrot (*Pusa Kesar*) and tomato (*F1 Hybrid Mohini-2555*) was used for the production of carrot and tomato pomace to use in the extrusion process. Pomace was dried, milled and stored in air tight containers at room temperature. The experiments were carried out with six different variables; corn flour (40-80%), bengal gram flour (20-30%) and pomace blend (5-20%) and machine parameters were barrel temperature (90–140°C), screw speed (250–400 rpm) and moisture content of (9-25%) using cross mixture design. Responses measured for the extrudates were; expansion ratio, bulk density, apparent density, color, hardness, fracturability and sensory parameters Optimization was carried out with the software Design Expert v8.0.7.1 on expansion ratio, bulk density, hardness, fracturability and overall acceptability. Optimized product contains 80% corn flour, 15% Bengal gram flour, 5% pomace blend, 140°C temperature, 400 screw rpm and 16.44% moisture content. Sorption isotherm were studied for the optimized extruded product and also 3 different packaging materials were studied for lycopene and beta carotene retention along with physical and sensory attributes at ambient and accelerated storage conditions.



Arpit Patel
(2011-2013)

BIO-ETHANOL PRODUCTION FROM POTATO WASTE



Dr. S. S. Kapdi

Abstract

Bio-ethanol is one of the bio-energy sources with high efficiency and low environmental impact. Various raw materials have been used for bioethanol production. In this study, potato peel wash water was chosen for bioethanol production; however, a various treatment method is needed to convert starch of potato peel wash water to glucose through hydrolysis processes. In order to obtain maximum fermentable sugar conversion, optimum parameters for the hydrolysis processes were determined by Full factorial design. The pH, total solid (mg/l), nitrogen (mg/l), total soluble solid ($^{\circ}\text{Bx}$), starch (%), COD (mg/l) and turbidity (%) of potato peel wash water was observed to be 6.25, 896.75, 90.50, 8.27, 13.25, 2500 and 80.25. The effects of acid concentration (1.4, 1.8, 2.2 and 2.6%), temperature (35, 50, 65 and 80 $^{\circ}\text{C}$) were evaluated with respect to glucose concentration by using DNS (dinitro salicylic acid) method. After completion of hydrolysis process fermentation was carried out by using *Saccharomyces cerevisiae*. The effect of yeast concentration (1.0, 3.0 and 5.0%), nitrogen source (0.1, 0.2 and 0.3 %) and time (36 and 72 h) were evaluated with respect to bioethanol yield by using Dichromate method. The optimization of fermentation parameters for bioethanol production was carried out by using Full Factorial design. Optimized condition for bioethanol production was 2.6% acid (H_2SO_4) concentration, 35 $^{\circ}\text{C}$ temperature, 3 h heating time, 5.0% yeast concentration and 0.3% nitrogen source for 72 h of fermentation. The yield of bioethanol for optimized condition was 58.10 g/l with yield of 70.14%.



Bhaumik Patel
(2011-2013)

PRECOOLING OF TOMATO FRUIT FOR SHELF LIFE EXTENSION



Dr. R. F. Sutar

Abstract

The present investigation entitled “Precooling of tomato fruit for shelf life extension” was carried out to find the effect of precooling and storage methods on shelf life of tomato fruit. The experiments were carried out with three precooling methods i.e., hydrocooling, forced air cooling and chilled water dipping at three cooling medium temperatures (4, 6 and 8°C). The precooled samples were stored in two storage conditions i.e. under room temperature (30±2°C) and refrigerated transport condition (13±2°C and 85-95% RH) storage. Tomato (cv. Narendra-2) of uniform maturity harvested at breaker stage was used for the study. During the storage, the physical parameters like physiological loss in weight (PLW), percent spoilage, ripeness and texture (firmness and skin resistance) in fruit were observed along with the chemical parameters (changes in total soluble solids, pH, titratable acidity and lycopene content) and organoleptic parameter (slice integrity and over all acceptability). It was observed from the precooling experiments that the chilled water dipping method took the least time (8.5, 16.17 and 19.75 min at of 4, 6 and 8°C cooling medium temperature, respectively) followed by hydrocooling and forced air cooling experiments at 4, 6 and 8°C cooling medium temperature which were 20, 21.50 and 24.50 min and 54.25, 84.50, 86.83 min, respectively. The study revealed that precooling with chilled water dipping was the fastest method for rapid removal of field heat to the desired temperature. It was observed that physiological loss in weight of tomato fruit increased under both the storage conditions but was higher under room temperature storage. The increase in ripeness was observed under both the storage conditions but it was rapid under room temperature storage. The maximum spoilage was observed for the samples stored under room temperature followed by refrigerated transport condition. The minimum change in texture was observed in samples stored under refrigerated transport condition. Increase in total soluble solids, pH and lycopene was at relatively slower rate under refrigerated transport condition than the room temperature storage. Titratable acidity decreased as the storage period increased rapidly under room temperature than refrigerated transport condition storage. Samples stored under refrigerated transport condition were rated higher for slice integrity and overall acceptability than those stored under room temperature. Under room temperature storage, 4°C forced air cooling treatment gave maximum shelf life of 27 days with advantage of 12 days over control. In control, 15 days shelf life was observed. The maximum shelf life of 39 days was found for samples subjected to 8°C hydrocooling had advantage of 18 days over control (21 days) under refrigerated transport condition storage.



Doctor Harsh
(2011-2013)

TECHNOLOGICAL ASPECTS FOR PRODUCTION OF BREAD FROM WHEAT-SORGHUM COMPOSITE FLOUR



Dr. Ameer Ravani

Abstract

Production of wheat-sorghum composite flour bread is the most appropriate technique for utilization of sorghum millet crop and to supply multigrain healthy product. The present study was undertaken to investigate effect of technological aspects for production of bread from wheat-sorghum composite flour. To do so, the experiments were carried out in two stages. Initially, wheat-sorghum composite flour was analyzed for physical, chemical and rheological characteristics, as they give information about formulation and optimization of machining properties, which would help in scaling up the process and in automation. It was found that the above properties were significantly affected by varying levels of sorghum in the composite flour blends. Pure refined wheat flour contains a higher amount of bio-chemical constituents like moisture, protein and fiber, while the fat content, ash content and carbohydrates are low in amount than pure sorghum millet flour. In the case of physical properties bulk density, tap bulk density, sedimentation value, water absorption capacity, wet gluten and dry gluten contents decreased and apparent porosity increased with increasing levels of sorghum flour incorporated with wheat flour. Secondly, the effects of fermentation time (45, 55, 65 and 75 min) and baking temperature (165, 180, 195 and 210°C) on the wheat-sorghum composite flour based breads were evaluated in detail with respect to the physical, textural and organoleptic quality of the final product. The above parameters were optimized for the production of acceptable quality of composite flour bread. It was found that the suitable level of sorghum into composite flour was 30% when fermented for 75 minutes and baked at 195°C, giving bread with optimum quality in terms of physical, textural and sensory characteristics. The composite flour blend of refined wheat flour and sorghum flour (70:30) had 11.6% moisture content, 14.17% protein content, 3.22% fat content, 67.03% carbohydrate, 1.34% ash content, 3.08% fiber content, 26.50% wet gluten content, 11.63% dry gluten content, 19.15 ml sedimentation value, 78.00% water absorption capacity, 0.40 g/ml bulk density, 1.37 g/ml tap bulk density, 0.71% apparent porosity, 22.37 g resistance to extension and 9.82 mm extensibility. This blend, when fermented for 75 minutes and baked at 195°C produced bread weighing 184.84 g with a volume of 438.33 cm³, specific volume of 2.44 cm³/g, height of 5.77 cm and firmness of 1437.73 g. The overall acceptability of this blend was found to be 5.44, and thus could be recommended for the bakery industry. These results suggest that superior quality of bread can be formulated with high sorghum incorporation into composite flour by utilizing suitable additives and preservatives.



Rajdeep Chauhan
(2011-2013)

DEVELOPMENT OF FORTIFIED MIXED FRUIT BAR USING WHEY PROTEIN CONCENTRATE



Dr. N. P. Sutar

Abstract

Fruit bar is a confectionery product also known as fruit slabs or fruit leather, prepared by drying fruit pulp after mixing with appropriate quantities of nutritive sweeteners and other ingredients appropriate to the product and dehydrated to form sheet which can be cut to desired shape and size. The present study is carried out to optimize different ingredients and drying temperature for development of fortified 'Mixed fruit bar' based on mango and banana, its quality characterization, shelf life study and cost evaluation. Central composite design (CCD) was used to conduct experiments by different combination of variables and optimization was carried out using response surface methodology. The effect of pulp ratio (1-9), whey powder (0-10%), pectin (0.2-0.6%), citric acid (0.3-1 %) and temperature (50-80°C) was studied on overall acceptability, protein content, hardness and moisture content of fortified mixed fruit bar. The best solution found with the desirability value of 0.70 having OAA 7.25, Protein 3.4 %, Hardness 5.03 N and Moisture 22.8% was Pulp ratio 6.68, Whey powder 7.1%, Pectin 0.32%, Citric acid 0.5% and Temperature 71°C. Storage study of optimized fortified mixed fruit bar was done at 64% RH and 27°C for 45 days. During storage, the moisture content, acidity and microbial load were found to be increasing, while protein content, pH, ascorbic acid, and hardness were decreasing. There was non-significant change in TSS. Sorption study of optimized fortified mixed fruit bar was carried out at 40°C and 90% RH. The shelf life of fortified mixed fruit bar was found to be 432 days, 360 days and 110 days for bi-axially oriented polypropylene (BOPP), High density polypropylene (HDPE) and Low density polypropylene (LDPE) respectively. The total cost of production of 100 kg fruit bar per day was estimated to be Rs. 40637.78 Total cost of production of 1 kg of fruit bar was estimated to be Rs. 406.38.



Harmandeep Lamsar
(2011-2013)

DEVELOPMENT OF PROBIOTIC ENRICHED CARROT BY VACUUM IMPREGNATION



Dr. R. V. Prasad

Abstract

Vacuum Impregnation (VI) is an innovative alternative to the traditional method of impregnation at atmospheric pressure. This technique was studied to develop minimally processed dried carrot slices enriched with probiotic cultures of *L. rhamnosus* (MTCC 5462) and *L. helveticus* (MTCC 5463). The quality and sensory characteristics of dried probiotic enriched carrot slices were evaluated. Fresh carrots were washed in clean water and peeled manually and top & tip were separated from the body and the remainder was cut into slices of 10, 12, 14 mm thickness. The carrots were then blanched by immersing in boiling water (100°C) for 4 min and rapidly cooled in chilled water. The probiotic cultures of *L. rhamnosus* (MTCC 5462) and *L. helveticus* (MTCC 5463) were grown in MRS broth, harvested by centrifugation to get a pellet of biomass and adjusted to 10¹¹ to 10¹² cfu/ml in sterile saline by adjusting OD in a spectrophotometer. This cell concentrate was subsequently added to pasteurized carrot juice to get a cell concentration of 10⁹ - 10¹⁰ cfu/ml which was used as probiotic impregnation liquid. VI experiments were carried out in specially designed equipment consisting of a reaction vessel and other ancillaries like lid, temperature socket, product addition socket. The assembly was connected to a vacuum pump. The variables in the VI of probiotic carrots were slice thickness (10, 12, 14 mm), temperature (25, 30, 35°C) and vacuum time (5, 10, 15 min). The time of vacuum had a significant effect on impregnation. Maximum impregnation of probiotic cultures was observed at 30°C for a vacuum time of 15 min and slice thickness of 12 mm. The impregnated samples were subjected to air drying at temperatures ranging from 40–60°C. Maximum probiotic count was observed at 40°C for both types of probiotic cultures and a decreasing trend in probiotic count noticed with increasing temperature. These VI probiotic carrot slices were stored in LDPE bags and physico-chemical, sensory and microbial evaluation was carried out for the product during the storage period of one month for samples stored at 37°C and 2 months for samples stored at 7°C. pH and water activity had negligible effect on product quality during storage. Overall acceptability score of 6 or more was noticed for 56 days and 30 days for samples stored at 7 and 37°C respectively. Probiotic count of more than 10⁶ was observed for samples till 56 days and 30 days for samples stored at 7 and 37°C respectively.



Hetal Bhatt
(2011-2013)

**STANDARDIZATION OF PRE TREATMENTS AND
PACKAGING FOR PRODUCTION OF "READY-TO-PUFF"
RICE USING MICROWAVE ENERGY**



Dr. D. C. Joshi

Abstract

Puffing of rice is an important unit operation for conversion of pre-gelatinized milled rice in to ready-to-eat snacks. The present investigation of pretreatments and packaging of milled rice and puffing using microwave energy was undertaken with the broad aim of developing and standardizing the technology for production of "ready-to-puff" rice. Study was undertaken to evaluate some of the pre-treatments (soy protein, guar gum and salt treatment) for improving puffing quality of puffing of rice. Combinations of pre-treatments of salt (0, 1, 2, 3%), soy protein (0, 2, 4, 6%) and guar gum (0, 0.5, 1.0, 1.5%) were evaluated for the puffing quality with respect to puffing yield, volume expansion ratio and overall acceptability. Further, the storage of pretreated rice in microwavable paper bag and low density polyethylene bag (LDPE) at room temperature was done. Shelf life of the pretreated and packed rice was determined with respect to maintaining the puffing quality. The actual puffing conditions like power level and time for the production of highest puffing quality of puffed rice from the pretreated, packed and stored rice were also standardized. The good quality "ready-to-puff" rice can be produced by pretreating the milled rice with 3% salt and packed in microwavable paper bags. The ready-to puff rice can be puffed as per the convenience using domestic microwave oven set at 900 W and 80 s.



Hiral Patel
(2011-2013)

PRODUCTION TECHNOLOGY OF WOOD APPLE (*FERONIA LIMONIA*) JUICE



Dr. H. P. Sharma

Abstract

The present investigation entitled “Production Technology of Wood Apple (*Feronia limonia*) Juice” was conducted with a broad aim of developing and standardizing the technology for production of wood apple juice. The processes were selected in such a way to use them in both at cottage level as well as in the scaled-up version for commercial production of wood apple juice. Initially, wood apple pulp was analyzed for its physico-chemical properties. The wood apple pulp was given pre-treatments of; 1) steaming at different time intervals (2, 4, 6 and 8 min), 2) pectinase enzyme treatment (incubation temperature: 35, 40, 45 °C; enzyme concentration: 10, 20, 30 mg/100 g; incubation time: 2, 4, 6 hrs) and 3) combined treatment (steaming and enzyme) at standardized conditions. The pre-treatments were standardized based on juice yield and TSS content in the juice. Once the pre-treatment was standardized, the wood apple pulp was then added with water in predefined ratio (2.5:1) and passed through various juice extraction machines such as basket centrifuge, fruit pulper, screw type juice extractor and hydraulic press. The average physico-chemical composition of wood apple pulp were moisture 74.03±0.71%, protein 1.96±0.19%, fat 3.31±0.34%, ash 1.35±0.08, reducing and total sugar 1.23±0.16 and 2.12±0.19 g/100g, respectively, pH 3.72±0.06, acidity 1.94±0.38% (citric acid), ascorbic acid 7.00±0.28 mg/100g, fiber content 0.65±0.18%, pectin content 2.12±0.15% and TSS content 11.56±0.56 °Bx. Combined (steaming and enzyme) treatment of wood apple pulp for 6 min steaming followed by pectinase enzyme treatment at incubation temperature 40°C, enzyme concentration 30 mg/100g and incubation time 6 h, resulted in maximum quantity of juice (i.e. 82.36% juice yield) with maximum TSS content of juice (5.3 °Bx). The maximum juice yield (85%) and maximum TSS content of juice (5.6 °Bx) was given by screw type juice extractor compared to other juice extraction machines. The screw type juice extractor was operated at four different rotational speeds (90, 120, 150 and 180 rpm). The maximum juice yield (86%) and maximum TSS content of juice (5.6 °Bx) was recorded at 150 rpm. The standardized conditions obtained for wood apple juice extraction were combined treatment (steaming for 6 min followed by pectinase enzyme treatment at incubation temperature 40°C, enzyme concentration 30 mg/100g and incubation time 6 h) and juice extraction using screw type juice extractor with the speed of rotation of 150 rpm. The TSS content in the juice was 5.6±0.21 °Bx, titratable acidity of the juice was 0.71 ± 0.16% (citric acid), ascorbic acid content in the juice was 4.73±0.115 mg/100g, total and reducing sugar content of wood apple juice were 1.53±0.119 and 1.14±0.102 g/100 g, respectively, pH of the juice was 3.71±0.02, pectin content of juice was 0.51±0.05 % and clarity of juice was 35.13±0.26%. The score obtained of overall acceptability of juice was 7.45.



Jainit Brahmhatt
(2011-2013)

EFFECT OF SOME UNIT OPERATIONS ON QUALITY OF *KAJUKATLI*



Dr. A. K. Sharma

Abstract

The *Kajukatli* is an indigenous sweet, prepared using principally cashewnut splits and sugar following traditional and manual methods. The preparation process involved grinding of soaked cashew nut splits, mixing with sugar, cooking, cooling, rolling and sheeting. From the preliminary study, it was observed that unit operations such as grinding and cooking play important role in deciding the product quality. Experiments were designed and conducted to study the effect of grinding and cooking on sensory and textural attributes of *Kajukatli*. Followed by storage study at room ($30\pm 2^{\circ}\text{C}$ & 65% RH) and refrigerated ($6\pm 2^{\circ}\text{C}$ & 90% RH) conditions was conducted for the sample prepared at optimized/standardized process parameters and packed in commercially available PVC containers. The parameters considered were: water addition while grinding (20-32%), grinding time (6-12 min) and cooking temperature ($70-100^{\circ}\text{C}$). Factorial design was followed for these three variables at four levels to study the effect and optimization. *Kajukatli* prepared with 28% water addition, grinding for 12 min and cooking at 100°C temperature had highest overall acceptability (8.9). Hardness and yield point of the sample were 354.98 and 344.49 g, respectively. *Kajukatli* so prepared had shelf life of nine (9) days at room condition while it lasted for more than thirty (30) days in refrigerated condition with acceptable sensory, textural and microbial attributes.



Nandkishor Patil
(2011-2013)

**HYBRID DRYING (OSMOTIC AND MICROWAVE VACUUM)
OF ELEPHANT FOOT YAM
(*AMORPHOPHALLUS PAEONIIFOLIUS*)**



Dr. P. P. Sutar

Abstract

The drying characteristics and quality of the elephant foot yam slices processed with hybrid (osmotic and microwave vacuum) drying were investigated. Osmotic dehydration was carried out using three variables namely, sucrose concentration (30, 40, 50 and 60% w/w), salt concentration (5, 7.5, 10 and 12.5% w/w) and dehydration time (10, 20, 30, 50, 70, 90 and 120 min). During the osmotic treatment pulsed microwave vacuum was applied for 2 min to the sample to enhance the water loss and solid gain. Azuara model predicted the moisture loss and solid gain by elephant foot yam slices during osmosis. It was observed that both the moisture loss and the solid gain increased with increasing concentration of osmotic solution. The best conditions found for osmotic dehydration process were 40% w/w sucrose concentration, 6 % w/w salt concentration and 70 min osmotic dehydration time, which gave 42.80 % moisture loss (Initial weight) and 14.65% solid gain (Initial weight). Further sample were dried using microwave vacuum. During microwave vacuum drying, effect of microwave power density (2, 4, 6 and 8 W/g) and pulsating ratio (1.312, 1.625, 1.983 and 2.250) were studied on quality of osmotically dehydrated elephant foot yam slices. The microwave vacuum drying at 1.625 pulsating ratio with microwave power density 4 W/g yielded product with highest overall acceptability score. Study of the sorption behavior of dehydrated elephant foot yam and shelf life prediction was carried out using Guggenheim, Anderson and deBoer (GAB) model.



Nikunj Shah
(2011-2013)

SUPERCritical FLUID EXTRACTION OF PAPRIKA OLEORESIN FROM RED CHILLI PEPPER



Dr. R. V. Prasad

Abstract

“Reshampatti” variety of red chilli (*Capsicum annuum* L.) is considered as one of the most important commercial spice crops which is used in various forms; as raw fresh chopped chilli; or ground to a paste, broken split, whole form and dried. Chillies are integral and the most important ingredient in different cuisines as it adds pungency, color and flavor due to presence of alkaloid capsaicin. Chilli also has many medicinal properties. The present investigation was undertaken to optimize supercritical fluid extraction parameters to obtain maximum capsaicin content, pigment content and oleoresin yield from red chilli pepper. The percent moisture, ash, protein, crude fat, crude fiber and carbohydrate of fresh red chilli was observed to be 83.54 ± 0.52 , 0.66 ± 0.08 , 3.55 ± 0.02 , 1.26 ± 0.01 , 4.03 ± 0.07 and 6.93 ± 0.58 respectively. The effects of temperature (35, 45, 55, 65 and 75°C), pressure (100, 200, 300, 400 and 500 bar), static time (60, 90, 120, 150 and 180 min) and particle size (0.25, 0.50, 0.75, 1.00 and 1.25 mm) were evaluated with respect to capsaicin content, pigment content and oleoresin yield in red chilli pepper. Optimization of supercritical fluid extraction was carried out by using central composite design. The optimized condition for capsaicin was 65°C temperature, 200 bar pressure, 90 min static time and 0.50 mm particle size. For pigment, it was 57.03°C temperature, 400 bar pressure, 100.87 min static time and 0.89 mm particle size. For optimized oleoresin yield, it was 65°C temperature, 400 bar pressure, 94.31 min static time and 0.50 mm particle size. Capsaicin, pigment and oleoresin yield, obtained at optimized SFE parameters were 2.126%, 16368.1 NCV and 5.945% respectively. Oleoresin obtained by optimized SFE condition was studied for its antimicrobial activity against four selective bacterial strains. Among these strains, highest antimicrobial activity was observed against *Escherichia coli* and moderate activity was seen against *Bacillus subtilis* and *Staphylococcus aureus*. Antimicrobial activity was not observed against *Salmonella typhi*.



Payal Patel
(2011-2013)

DEVELOPMENT OF LACTOSE HYDROLYZED WHEY- MILK-FRUIT BEVERAGE



Dr. G. Tagalpallewar

Abstract

Functional food according to a widely accepted definition is any modified food that may provide a health benefit beyond the nutrients it contains. The sapota fruits are having some functional properties like, it inhibits formation of cancerous cells implicated with stomach cancer and may enhance immune system, anti-anemic and riboflavin (B2) of sapota is necessary for red blood cell formation; anti-body production cell respiration and growth; and niacin (B3), dilates blood vessels, reduces high blood pressure and lowers blood cholesterol and triglycerides significantly. Furthermore, Whey is a liquid by-product of dairy industry. It is now widely accepted to contain many valuable constituents. But whey utilization is limited due to its very high lactose content (About 70% on dry weight bases). Lactose level limits the consumption of whey by individuals who have a deficiency of the small intestinal enzyme lactase. As a result whey disposal has become a major problem for the dairy industry. Therefore, Lactose hydrolysis, which is of great concern due to nutritional and technological reasons, was done mixture of cheddar cheese whey and whole milk to prepare beverage by β -galactosidase enzyme. Central composite design (CCD) was used to conduct experiments and optimization was carried out using response surface methodology (RSM). The effect of incubation temperature, incubation time, pH, enzyme concentration and milk: whey ratio was evaluated with respect to percent lactose hydrolysis and sensory attributes like, color and appearance, taste and flavor, consistency and overall acceptability. The best solution was found with the desirability value of 0.97 having degree of hydrolysis 83.11%, color and appearance score 8.09, taste and flavor score 8.07, consistency score 8.63, and overall acceptability score 8.22 at incubation temperature 34.31 °C, incubation time 203.90 min, pH 6.84, enzyme concentration 5.01 U/g of lactose and milk to whey ratio 4.00. Furthermore, to prepare lactose hydrolyzed whey-milk-sapota beverage, level of sugar and sapota pulp was also optimized. The good quality of lactose hydrolyzed whey-milk-sapota beverage can be prepared with sapota pulp 8.04 % and sugar level 9.31 % having the highest scores of color-appearance (7.99), taste and flavor (7.52), consistency (8.31), OAA (8.04) and viscosity (107.10 cp). Also the level of stabilizer like pectin addition was optimized. The highest scores of color-appearance (7.15), taste and flavor (7.02), consistency (7.75) and OAA (7.49) were found with 0.1% of pectin addition. The shelf-life of lactose hydrolyzed milk-whey-sapota beverage was estimated to be 12 days at refrigerated conditions in glass bottles.



DEVELOPMENT OF THE PRESERVATION TECHNIQUE FOR IDLI BATTER



Prarthana S. P.
(2011-2013)

Dr. D. C. Joshi

Abstract

Idli, a traditional breakfast food of India based on rice-black gram combination, is a fermented, leavened, soft, spongy textured product. *Idli* batter has very short shelf-life because of its high moisture content and live fermentation. There is a demand for ready-to-cook *idli* batter in packaged form with moderate shelf-life. Thermal preservation is not feasible as the batter coagulates or *idli* is formed on heat application. Study was undertaken to evaluate some of the non thermal methods of preservation (sonication, irradiation and bio-preservatives) for extension of shelf-life of fresh *idli* batter. *Fresh idli* batter after fermentation and packing was sonicated at different power levels (60, 100 and 182 μm) for different exposure times (5, 8, 12, and 15 min) or irradiated (0.5, 0.75, 1.0 and 1.25 kGy) or preserved by adding Nisin (7.5 ppm) and Potassium Sorbate (2000 ppm). The quality responses in terms of pH, acidity, standard plate count and the overall acceptability were evaluated as a function of the preservation treatments. All the three preservation techniques enhanced the shelf-life of *idli* batter substantially.

The shelf-life increased with the increase in sonication amplitude for most the sonication times. The shelf-life also increased with the increase in irradiation frequencies and with the addition of preservatives. Preservation	Ambient Storage (30 \pm 2 $^{\circ}$ C)	Refrigerated storage (7 \pm 1 $^{\circ}$ C)
No treatment	1 day	8 days
Sonication at 100 μm for 8min	6 days	20 days
Irradiation at 1.25 kGy	7 days	64 days
Addition of Nisin (7.5ppm) + Potassium Sorbate (2000ppm)	10 days	25 days



Anilkumar. S. I.
(2012-2014)

SUPERCritical FLUID EXTRACTION OF ESSENTIAL OIL FROM CURRY LEAVES



Dr. R. V. Prasad

Abstract

Murraya koenigii L. Spreng belongs to family Rutaceae is a deciduous to semievergreen aromatic tree in India, Bangladesh, Nepal, Malaysia, Sri Lanka and Burma. It is commonly known as 'curry patta' and is popular as a spice and condiment in south India. It has specific aromatic odor because of the presence of essential oil, mainly concentrated in leaf, and is used for various purposes in food and pharmaceutical industry. The present investigation was undertaken to optimize supercritical fluid extraction parameters to obtain superior quality of curry essential oil. The percent moisture, ash, protein, carbohydrate, crude fat and crude fiber of fresh curry leaves was observed to be 65.21, 3.9, 5.65, 15.99, 0.82, and 7.06, respectively. The effects of temperature (35, 40, 45, 50 and 55 °C), pressure (100, 150, 200, 250 and 300 bar), dynamic time (20, 37.7, 55, 72.5 and 90 min) and particle size (0.2, 0.4, 0.6, 0.8 and 1.0 mm) were evaluated with respect to the essential oil yield and the β -caryophyllene in essential oil. The optimization of supercritical fluid extraction was carried out by using central composite design of experiment. Optimized condition for super critical fluid extraction of essential oil was 45°C temperature, 125 bar pressure, 0.69 mm particle size and 45 min dynamic time. Essential oil extracted at optimized SFE condition had essential oil yield of 1.3% and β -caryophyllene of 16.88%. The synthetic antioxidant activity of BHA showed maximum activity of 88%, whereas the essential oil showed an activity of 76%. Essential oil obtained by optimized SFE condition was studied for its antimicrobial activity against four selective bacterial strains. Among these, strains, highest antimicrobial activity was observed against *Escherichia coli* and moderate activity was seen against *Bacillus subtilis* and *Staphylococcus aureus*. Antimicrobial activity was not observed against *Salmonella typhi*. Essential oil of curry leaves obtained by SFE and hydrodistillation were compared. It was observed that SFE provided shorter extraction time, higher essential oil yield and higher percentage of β -caryophyllene.



Romin Vahora
(2012-2014)

PROCESS TECHNOLOGY FOR SORGHUM BASED SOY ENRICHED EXTRUDED PRODUCT



Dr. R. F. Sutar

Abstract

Grain characteristics relevant for suitability for extrusion, in respect of three varieties of sorghum were studied. Linjer goti variety grown around Surat and nearby areas was found to have suitable extrusion characteristics. The present study was undertaken for utilization of millet in extrusion using sorghum (*Sorghum bicolor* L.). Defatted soy flour incorporation in Sorghum flour prepared from Linjer goti was carried out to obtain nutritious millet pulse blend for extrusion cooking. Flours were stored in air tight containers at room temperature. The experiments were carried out with six different variables sorghum flour (50-70%), corn flour (10-30%) and defatted soy flour (5-20%) and machine parameters were barrel temperature (100 –140°C) , screw speed (250 – 400 rpm) and moisture content of (12-18%) using cross mixture design. Responses measured for the extrudates were; expansion ratio, bulk density, hardness, fracturability and sensory parameters. Optimization was carried out with the software Design Expert v9.0.7.1 on expansion ratio, bulk density, hardness, fracturability and overall acceptability. Optimized product contains 70% sorghum flour, 22.5% corn flour, 7.5% defatted soy flour, 140°C barrel temperature, 350 rpm screw speed and 12% moisture content. Sorption isotherm was studied for the optimized extruded product. Samples were kept at different relative humidity (RH 40- 70%) and temperature (30- 60°C), for the estimation of responses i.e. moisture content and water activity. Increased storage temperature and relative humidity led to increase the sorption rate of extruded snack.



Ajay Patel
(2012-2014)

PROCESS DEVELOPMENT OF NUTRI – RICH FOOD FOR PREGNANT AND LACTATING WOMEN



Dr. R. B. Modi

Abstract

The present investigation entitled “Process Development of Nutri-Rich Food for Pregnant/Lactating women” was conducted with an idea to prepare and standardize the process of making Nutri-Rich Food. The objectives of the study were to optimize the germination and processing parameters, to formulate the Nutri-Rich Food for pregnant and lactating women and to characterize the food for nutritional and quality parameters. To cater the elevated demand of nutrition, moth bean and finger millet were selected as major ingredients, being richer sources of iron and calcium respectively. For better nutritional quality, digestibility and organoleptic property, barley malt extract was also selected as major ingredient. These ingredients also supply ample and high quality vegetable proteins, for better foetal growth of child and better health of mother. The millets and legumes contain certain anti-nutrients like phytic acid and trypsin inhibitor activity, which needed to be addressed. The processing steps like soaking and germination helped to lower antinutritional factors and improve nutritional profile. The best germination time was optimized for both, moth bean and finger millet based upon reduction in the phytic acid and trypsin inhibitor activity and increase in amylase activity with optimum yield. The best germination period selected for moth bean was 36 h at 30°C temperature and 80% relative humidity with 85.56% increase in amylase activity, 50.04% reduction in phytic acid level, 39.98% reduction in trypsin inhibitor activity and 27.73% yield. While for finger millet the best germination time selected was 24 h at 30°C temperature and 80% relative humidity having 230.48% increase in amylase activity, 60.02% reduction in phytic acid content, 49.96% reduction in trypsin inhibitor activity and 53.96% yield. Roasting of germinated grains reduced the moisture content and enhanced the flavor of the grain. Preliminary investigations revealed that addition of barley malt extract and skim milk improved the organoleptic and reconstitution properties of dried foods. Response Surface Methodology (RSM) based on Central Composite Rotatable Design (CCRD) at five different levels was adopted for three variables viz. moth bean flour, finger millet flour and barley malt extract, to optimize the formulation for Nutri-Rich Food. Optimized product was prepared by mixing germinated and roasted moth bean (21.98%) and finger millet (19.37%) flours with skim milk and barley malt extract (20%), followed by cooking for 5 minutes at 100°C temperature. The heated gruel was dried in vacuum dryer at 70°C temperature and 700 mm of Hg vacuum, till 8% moisture in the dried product, which was further converted in to fine powder by grinding and sieving. The optimized product scored 7.8, 7.4, 7.7 and 7.6 for color and appearance, flavor, consistency and overall acceptability, respectively during sensory evaluation based on 9 point hedonic scale. The final Nutri-Rich Food contained 8.0, 16.74, 3.01, 3.30, 75.79, 1.16, 1.73, 8.11% of moisture, protein, fat, ash, carbohydrate, crude fiber, reducing sugar and total sugar, respectively. The dried Nutri-Rich Food also possessed better reconstitution properties i.e. solubility (60.62%), bulk density (2.91 gm/cm³) and flowability (2.36 minutes). The product contained good amount of iron, calcium and zinc amounting 5.70 mg/100g, 284.49 mg/100g and 1.79 mg/100g, respectively.



Ashishgiri Bava
(2012-2014)

SUPERCRITICAL CO₂ EXTRACTION OF CAROTENOIDS FROM VACUUM DRIED PUMPKIN POWDER AND ITS UTILIZATION IN SELECTED FOOD PRODUCTS



Dr. G. Tagalpallewar

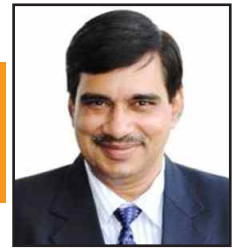
Abstract

Pumpkin is a good source of carotene. Utilization of fruit to combat vitamin A deficiency (VAD) as a source of carotene vacuum dried pumpkin powder were produced in bulk and analyzed for its physico-chemical characteristics and used for optimization of supercritical fluid extraction parameters (temperature, pressure, dynamic time and particle size) on the basis of carotenoid yield and β -carotene content. β -carotene content was determined using HPLC. The optimized pumpkin carotenoid extract was studied for its β -carotene content for 45 days at different storage temperature viz. 30°C and -18±2°C. The SCFE pumpkin carotenoid incorporated in selected food products viz. butter, ice cream and cookies to make them enrich with carotene content at various levels and analyzed for its chemical composition, sensory evaluation, colour value and β -carotene content from the product. Supercritical fluid extraction (SFE) has emerged as a highly promising environmentally caring technology for selectively recovering thermally labile bioactive ingredients from natural sources. The nutraceutical produced by SFE using carbon dioxide (CO₂) at near-ambient temperatures are preferred by consumers due to their superior quality and higher bioactivity without the problems of residual solvent and microbial contamination In SCFE of pumpkin carotenoid the optimum carotenoid yield (0.6 g/100g) and β - carotene content (154.912 mg/100g) was found when the super critical fluid extraction system was operated at 70°C temperature, 375 bar pressure, 50 min dynamic time and keeping particle size of vacuum dried pumpkin powder of 0.6 mm. pumpkin carotenoid extract stored at a temperature of 30°C showed gradual decrease of β -carotene content. Changes of β -carotene content stored at -18±2°C were very less prominent till 45 days. The SCFE pumpkin carotenoid extract was utilized in selected food products viz. butter, ice cream and cookies and the effects of incorporation of pumpkin carotenoid extract at various levels on β -carotene content, sensory quality and color values after processing were evaluated. In butter, ice cream and cookies the optimized (maximum sensory score) the level of incorporation of carotenoid extract β -carotene content 0.14±0.00 mg/100g at 100 μ l/100g level, 0.49±0.00 mg/100g at 400 μ l/100g level and 0.25±0.00 mg/100g at 350 μ l/100g was found, respectively.



Anil Kumar
(2012-2014)

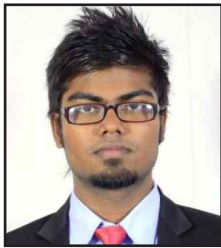
ENERGY AUDIT IN ONION DEHYDRATION PLANT



Dr. S. S. Kapdi

Abstract

The present global scenario of energy crisis has forced food processing industry to become more energy conscious. With liberalization of industrial policy, the food processing industry is facing challenges both in terms of quality and plant performance. As operations performed in food processing plants especially in onion processing line are quite energy intensive, the check on energy usage is in priority concern. Engineering services in food plants are considered as the area where simple plant optimization measures can lead to substantial and almost immediate savings. In onion processing line, electricity was the main energy utilized for operation of machineries, such as prime movers, dehumidification system, chilled water system and compressed air system while the thermal energy was used for drying of onion. For any industry, a perfect energy audit being first step to identify and suggest the area of energy wastages and set realistic goals for achievable savings. During the study, preliminary energy audit was done by carrying out visits to the plant and collection of the past electricity bills, coal consumption data and product produced data available with the plant. The detailed energy audit was carried out in onion processing line in which the energy consumed by the unit processes were determined and the energy consuming devices were tested for their performance. The total power consumed in the line one for onion dehydration was 123.25 kW inclusive of all unit operations. Milling section was the other important unit in onion dehydration plant with production capacity of 20-25 MT/ day. The total power consumed in milling section was 146.46 kW. The performance evaluation of hot air generator was done and it was revealed that the two units of hot air generators were working at an efficiency of 65.15 and 59.29%, respectively. The total power consumed by hot air generator for line one was 198.39 kW. The refrigerating units were tested for their performance. The specific power consumption of the chiller unit for cooling ii section and dehumidification system were found to be 0.97 and 0.649 kW/TR, respectively. The effectiveness of the cooling tower was found to be 0.14. The illuminance level of the preparation, drying and packaging section were determined. The ILER of the preparation section during the day and night operation are 0.61 and 0.27, respectively. The ILER of the drying section and packaging section during the day and night operation were found to be 0.73, 0.19, 0.42 and 0.39, respectively. The possible suggestions for conserving energy are made and the reduction in energy consumption be suggested to revised the contract demand of electricity supply from 800 kVA to 875 kVA.



Chandan Singh
(2012-2014)

EFFECT OF SELECTED STARTER CULTURES ON QUALITY OF IDLI BATTER AND IDLI



Dr. J. K. Momin

Abstract

Idli is a traditional cereal/legume – based naturally fermented steamed product with a soft and spongy texture which is highly popular and widely consumed as a snacked food item in India. The predominant fermentation microflora comprises lactic acid bacteria and yeasts and causes an improvement in the nutritional, textural and flavor characteristics of the final product. In this background, lactic acid bacterial cultures and yeast cultures in combinations were taken to study its effect on quality of *idli* batter and *idli*. Combinations of starter culture were done by taking one lactobacilli culture (@0.5%) e.g., *Lactobacillus fermentum* AI2, *Lactobacillus casei* NCDC 299, *Lactobacillus rhamnosus* MTCC 5462 and *Lactobacillus helveticus* MTCC 5463 other LAB culture (@0.5%) e.g., *Streptococcus thermophilus* MTCC 5460 *Pediococcus cereviceae* NCIM 2171 and *Leuconostoc mesentroides* 029 and one yeast culture (@0.5%) e.g., *Candida versatilis* NCIM 3431, *Saccharomyces cereviceae* with total @1.5% of inoculums. Total 24 combinations were made. A control without externally starter culture added was also prepared. These cultures were grown in pre-sterilized paneer whey and this *biomass* of particular pure microorganisms was utilized as inoculum for batter fermentation and added after grinding. These batters were kept at 30°C for 14 hours for fermentation. After fermentation, these products were subjected to rise in batter volume (%), pH and acidity analysis while *idli* prepared from batter were subjected to sensory analysis. Effect of combinations of starter culture on *idli* batter were found statistically significant ($P < 0.05$) on batter volume rise (%), pH and acidity. Out of 24 combinations best three combinations based on rise in batter volume (%) and overall acceptability of *idli* were *Lactobacillus casei* NCDC 299 + *Streptococcus thermophilus* MTCC 5460 + *Saccharomyces cereviceae* (299+MD2 + S. Cer.) i.e. T24, *Lactobacillus fermentum* AI2 + *Streptococcus thermophilus* MTCC 5460 + *Saccharomyces cereviceae* (AI2 +MD2+S. Cer.) i.e. T18 and *Lactobacillus fermentum* AI2 + *Leuconostoc mesentroides* 029 + *Saccharomyces cereviceae* (AI2+ 029 +S. Cer.) i.e. T22. T24, T18 and T22 had 103.99, 103.97 and 99.41%, respectively while control had 96.88%. Based on the rise in batter volume and sensory evaluation of product prepared, out of 24 combinations best three combinations i.e., T24, T18 and T22 along with a control sample were studied for rise in batter volume, pH, acidity and microbial analysis while *idli* for sensory evaluation. T24 and T18 had higher rise in batter volume than control (83.33) and T22 had near to control. pH of batter was non-significant and ranged between 5.0-5.1. Acidity of control was 0.46 while in T18, T22 and T24 it was 0.48. The increase in the lactobacilli count (log cfu/g) was found significantly different ($P < 0.05$). Increase in yeast count was found higher in T18, T22 and T24 compared to control. The effect of culture combination was significant ($P < 0.05$) on flavor, body and texture and overall acceptability while color and appearance was non-significantly ($P > 0.05$) affected. The overall acceptability of the products varied from 8.25 to 8.29 with different combinations of starter culture while for control it was 7.74. The order of preference with respect to overall acceptability score was T22 > T24 > T18 > C while for flavour the order was T22 > T18 > T24 > C.



Gayatri Mishra
(2012-2014)

POPPING OF SORGHUM GRAINS USING MICROWAVE ENERGY



Dr. D. C. Joshi

Abstract

Pop sorghum, like popcorn is a traditional popped snack product, and is very popular in India. Considering the aspect of expandability of sorghum grain and better digestibility of the popped product and more the matter of convenience, an attempt was made to produce popped sorghum in a domestic microwave oven by using suitable pretreatments. In this study, the effect of physical and chemical properties on popping (popping yield and volume expansion ratio) and sensory qualities (overall acceptability) of four different varieties of sorghum, namely *Nandel*, local *Red*, *Mugad* and *GJ-42* were studied. Suitable variety of sorghum grain was selected having higher popping and sensory qualities. The selected variety was popped with different pretreatments such as moisture conditioning (12-20% wb), addition of sodium chloride salt (0-2%) and oil (0-10%). Optimization of pretreatments was carried out using response surface methodology, for a Box–Behnken design at three levels for three parameters. The optimized pretreated sorghum grain was popped at different microwave power densities (9, 12 and 18 Wg⁻¹) and residence times (100, 140 and 180 s) in a domestic microwave oven and from which optimization of microwave process parameters was done to produce better quality of pop sorghum. *Mugad* variety of sorghum with small grain size, lower sphericity, high bulk density, medium grain hardness, higher pericarp thickness and higher amylose content was found to have the highest popping characteristics. The grain moisture content had significant effect on popping and sensory qualities of pop sorghum. Maximum expansion and yield was obtained at an optimum moisture content of 16.62% with addition of 0.55% sodium chloride and 10% oil. The pretreated sorghum was found to be popped well at higher microwave power densities and the optimized condition was found to be 18 Wg⁻¹ for 140 s.



Mehul Prajapati
(2012-2014)

**DEVELOPMENT OF MICROENCAPSULATION TECHNIQUE
FOR PROBIOTIC *LACTOBACILLUS RHAMNOSUS* MTCC
5462 WITH SELECTED COATING MATERIALS**



Dr. R. V. Prasad

Abstract

Probiotics are defined as essential live microorganisms that, when administered in adequate amounts, confer health benefit on the host. Survival and stability in the gastrointestinal tract is being debated by scientists. To overcome these limitations, microencapsulation techniques are receiving considerable attention. Microencapsulation is a physicochemical or mechanical process to entrap a substance in a material in order to produce particles with diameters of a few micrometers to a few millimeters. The present investigation is undertaken to develop the process of microencapsulation of live probiotic culture by extrusion and emulsion process using chitosan and κ -carrageenan as coating polymers. Probiotic *Lactobacillus rhamnosus* MTCC 5462 was activated in MRS broth, harvested and the biomass was adjusted to 10^{11} to 10^{12} cfu/ml in sterile saline and then cell concentrate was added to sodium alginate and encapsulation was done by spraying in calcium chloride solution. The process of encapsulation (i.e. extrusion and emulsion) and concentration of chitosan or κ -carrageenan as coating had a significant effect on the probiotic cell viability and size of beads. Emulsion process gave lower bead size and better cell viability. Chitosan used as coating material gave maximum cell viability and minimum bead size. The probiotic cells in encapsulated beads were active in simulated gastric conditions at pH 2.0 and in bile salts at pH 8.0. The microencapsulated probiotic beads were stored at ambient and refrigerated condition for 42 days. The cell viability reduced more at ambient condition than at refrigerated condition but they were above 10^6 cells/g which was recommended for any probiotic formulations



Savan Panchal
(2012-2014)

OPTIMIZATION OF OHMIC HEATING PROCESS PARAMETERS FOR ENHANCED SHELF LIFE OF PAPAYA PULP



Dr. A. K. Sharma

Abstract

Papaya (*Caricapapaya L.*) is an important fruit crop and known for high nutritive and medicinal value due to high Vitamin C & A. Papaya pulp is used in preparation of jams, mixed fruit drinks, baby food, confectionary, ice-cream, yogurt and bakery products. Conventionally it is being obtained from fully ripened papaya fruit by washing, peeling, deseeding, pulping and thermal processing at $94\pm 2^\circ\text{C}$ for minimum 2 min, for acceptable sterility. Overheating is in general practice to meet the safety requirements. This results in great loss of heat sensitive nutrients. Ohmic heating is considered as a better and promising alternative to the conventional heat process in which rapid and volumetric uniform heating is possible. Therefore, this study was undertaken with the overall objective of developing ohmic heating setup and optimizing the process parameters: voltage (60-80 V), temperature (70-90°C) and holding time (0-10 min) for maximum reduction in enzyme activity and total viable count, and minimum reduction in ascorbic acid. Factorial design was followed for these three variables to study the effect and optimization. The optimum level for maximum reduction of total viable count, enzyme activity and maximum retention of ascorbic acid was: 60 V, 70°C and 10 min for voltage, final temperature and holding time, respectively. The result showed that the ohmic processed pulp was stable and acceptable even after eighty two days storage under refrigerated condition.



Neel Parikh
(2012-2014)

**PRESERVATION OF EGGPLANT
(*SOLANUMMELONGENA*) APPLYING OSMOTIC AND
MICROWAVE-VACUUM DRYING**



Dr. A. K. Sharma

Abstract

The polyphenol inactivation study of sliced eggplant was carried out at different pretreatments: hot water (70 and 80°C), steam (atmospheric pressure), microwave (0.5, 1, 2, 3 and 4 W/g) for one to five min and different chemicals- citric acid, ascorbic acid and malic acid and salts for two to seventeen min were carried out. Residual Polyphenol oxidase activity was 11.45 to 92.22 and 40.90 to 87.04 in thermal and chemical treatments, respectively. Visually best product was observed at citric acid, ascorbic acid and malic acid having concentrations of 0.1, 0.25, and 0.25% w/v with residual activity 86.6%. The drying characteristics and quality of the eggplant slices were preserved with osmotic and microwave vacuum drying. Microwave pulsed assisted osmotic dehydration was studied for best condition of three variables, salt concentration (5, 10 and 15% w/v), vacuum (10, 20 and 30 kPa) and dehydration time (10, 20, 30, 40, 50 and 60 min). During the osmotic treatment, pulsed microwave vacuum was applied for 1 min to the sample to enhance the water loss and solid gain. Azuara model fitted and predicted the moisture loss and solid gain by eggplant slices during osmosis. It was observed that both the moisture loss and the solid gain increased with increasing concentration of osmotic solution. The best condition found for osmotic dehydration process was 10% w/v salt concentration, 20 kPa vacuum and 60 min osmotic dehydration time, which gave 15.37% moisture loss (Initial weight) and 3.379% solid gain (Initial weight). Further, rinsed and blotted samples were dried using microwave vacuum. Effect of microwave power density (0.5, 1, 2, 3 and 4 W/g) and vacuum (10, 20 and 30 kPa) were studied on quality of the osmotically dehydrated microwave vacuum dried eggplant slices. The microwave vacuum drying at 10 kPa vacuum with microwave power density 2 W/g yielded products with highest overall acceptability score. Study of the sorption behavior of dehydrated eggplant and shelf life was predicted, using GAB model, to be on 135 days in LDPE and 438 days in HDPE bags.



Piyush Jadav
(2012-2014)

USE OF SUPERCRITICAL CO₂ EXTRACTED CAROTENOIDS FROM TOMATO POMACE IN SELECTED FOOD PRODUCTS



Dr. S. H. Akbari

Abstract

Tomato (*Lycopersicon esculentum*) is a fruit used mainly as a vegetable both in fresh as well as in processed forms. Lycopene, an important carotenoid in tomatoes is responsible for the red color in tomatoes. The antioxidant capability of lycopene has led to promising results in decreasing the risk of some illnesses and diseases. Tomatoes are processed for the production of many useful food items such as juice, paste, puree, catsup, sauce, etc. Tomato pomace is the main by-product of such processing and does not have high economic utilization at present. The tomato processing waste (pomace) having peel, some pulp and seed has a high amount of lycopene and hence, is considered to be the potential raw material for production of natural lycopene. However, the pomace is a high moisture by-product and therefore, it is require to dry it appropriately for preservation and then used for lycopene extraction. Supercritical fluid extraction (SFE) has emerged as a highly promising environmentally benign technology for selectively recovering thermally labile bioactive ingredients from natural sources. The nutraceutical produced by SFE using carbon dioxide (CO₂) at near-ambient temperatures are preferred by consumers due to their superior quality and higher bioactivity without the problems of residual solvent and microbial contamination. Lycopene is a natural antioxidant and having functional and nutraceutical properties as well as can be used as a natural coloring agent in food. It can be satisfactorily intended in the food systems as a functional ingredient. The tomato carotenoid extract was characterized for its chemical properties and utilized in three different products i.e. ice cream, filling cream (biscuit) and jam. The optimization of level of incorporation of lycopene extract was carried by sensory analysis and color measurement. The incorporation level of 0.1% in ice cream, 0.6% in filling cream (biscuit) and 0.08 % in jam was optimized. The stability of lycopene content was found to be greater in ice cream as compare to jam and filling cream (biscuit). The maximum lycopene content was observed initially in the ice cream (0.151 mg/100g). The negligible decreasing trend of lycopene content was observed after 35 days to 49 days. The minimum lycopene content 0.148 mg/100g was observed at 49th days of storage. The lycopene content in filling cream (biscuit) and jam was 0.879 mg/100g and 0.124 mg/100g in the fresh sample respectively and during storage period, the lycopene content was deceased and observed 0.731 mg/100g and 0.091 mg/100g at 49th day of storage.



Srishti Saxena
(2012-2014)

TECHNOLOGY FOR THE DEVELOPMENT OF OSMOTICALLY DEHYDRATED WHOLE AONLA FRUIT



Dr. Ameer Ravani

Abstract

Aonla is an important fruit crop of tropical and subtropical region of India. It finds a special place in India due to its tremendous medicinal values and high vitamin C content. Considering the fact that the fresh Aonla fruits are not popular as a table fruit due to their high astringency and its limited storability due to its high perishable nature, an attempt was made to preserve Aonla fruit by osmotic dehydration. For osmotic dehydration four variables with three levels of each were used; ultrasonication time (0, 15, 30 min), solution to fruit ratio (4:1, 6:1, 8:1), sugar syrup concentration (40, 55, 70 °Brix) and osmotic time (24, 48, 72 h). On increasing ultrasonication time and osmotic time mass reduction and water loss increased, while solid gain increased on increasing osmotic time. Ascorbic acid loss increased with increase in sugar syrup concentration and solution to fruit ratio. The optimum conditions for osmotic dehydration were 30 min ultrasonication time, 6:1 solution to fruit ratio, 58 °Brix sugar syrup concentration and 50 h osmotic time, which gave maximum mass reduction and water loss with minimum solid gain and ascorbic acid loss. For finished drying four different air temperatures such as 50, 60, 70 and 80°C were investigated for osmotically pretreated Aonla. Significant effect of above variables was observed on the final product quality. On the basis of sensory attributes, sample dried at 60°C was selected for further study, which had 213 mg/100g ascorbic acid content, 7.21 N hardness and 0.08 OD non enzymatic browning and it takes 5 h for drying. Storability of osmotically dehydrated Aonla can be enhanced upto 105 days at 30±2°C packed in HDPE pouch of 200 gauge.



Rahul Moradiya
(2012-2014)

MODIFICATION AND EVALUATION OF RAW BANANA PEELING MACHINE



Dr. R. F. Sutar

Abstract

Banana peeling is the primary and most important operation in banana processing. Manual peeling is relatively slow operation and involves substantial labor when a large number of peeled bananas are desired, so power operated banana peeling machine was designed and developed, suitable for small scale processing unit. Robusta variety of banana was selected for the study. Some physical properties of unripe banana fruit were determined. The properties like weight, effective length, diameter of fruit (with peel and without peel), of banana were determined. Banana peeling machine is modified and evaluated based on physical properties of banana fruit. The entire machine was divided into four units namely frame, conveying unit, peeling unit and power transmission unit. The conveying unit consisted of main components like belts, pulleys, belts support plate, pusher, guiding channel, slitting unit and pulp collection channel. The second important unit of modified banana peeling machine was peeling unit, consisting of telescopic channel, roller, pins, spring and separating unit. The power transmission unit consisted of electric motor and variable frequency drive. The average respective values of weight, effective length of fruit were 93.64 g and 133.30 mm, respectively for Robusta. The average diameter of banana with peel at top, middle and bottom of Robusta variety was found to be 31.60, 33.01 and 30.20 mm, respectively. The average thickness of peel at top, middle and bottom of Robusta variety was 3.72, 3.97 and 4.02 mm, respectively. The average diameter of banana without peel at top, middle and bottom of Robusta variety was 24.16, 25.06 and 22.65 mm, respectively. Pulley rpm were to be measured 27, 32, 37, 42, 48, 54, 59, 64, 70 and 75, respectively, for VFD reading from 1.3 to 2.2. Banana peeling machine was conceptualized, designed and fabricated by combination of gripping, slitting and scrapping mechanisms. The maximum and minimum feed rate of banana peeling machine was observed to be 118.07 kg/hr at 75 rpm and 78.19 kg/hr at 27 rpm, respectively. The maximum and minimum effective capacity of banana peeling machine was observed to be 84.55 kg/hr at 64 rpm and 66.78 kWh at 54 rpm, respectively. The peeling efficiency of machine increased as rpm of horizontal pulley increased up to 32 rpm. However, as the rpm was increased further peeling efficiency of machine decreased. The peeling efficiency of the machine was found to be minimum 75% at 75 rpm and maximum 96% at 32 rpm. The maximum and minimum damage banana peeling machine observed 25% at 75 rpm and 4% at 32 rpm respectively. Average power required to operate the machine under no load condition was observed to be 1.43 kW while average power required for operating the peeling machine was 2.06 kW under full load condition.



Dipen Pandya
(2013-2015)

SOLVENT EXTRACTION OF LYCOPENE FROM TOMATO PROCESSING WASTE



Dr. S. H. Akbari

Abstract

Tomato (*Lycopersicon esculentum*) is used mainly as a vegetable both in fresh as well as in processed forms, in food preparations. Lycopene, an important carotenoid in tomatoes is responsible for the red color in tomatoes. The antioxidant capability of lycopene has led to promising results in decreasing the risk of some illnesses and diseases. Tomatoes are processed for the production of many useful food items such as juice, paste, puree, catsup, sauce, etc. The tomato processing waste (pomace) having peel, some pulp and seed has a high amount of lycopene and hence, is considered to be the potential raw material for production of natural lycopene. Majority of companies that are into the business of manufacturing fruit extracts, prefer conventional solvent extraction method. The main reason for the adoption of solvent extraction method is the cost of technology, it is a cheaper technology as compared to other modern technologies and there is comparatively more recovery of extract by this method. Lycopene is a natural antioxidant having functional and nutraceutical properties as well as can be used as a natural coloring agent in food. It can be satisfactorily intended in the food systems as a functional ingredient. The tomato processing waste (pomace) was characterized for its chemical properties. The optimization of the solvent extraction process for the maximum recovery of lycopene from tomato pomace was carried out by selecting the suitable solvent system, temperature-time combination and feed to solvent ratio, i.e. Acetone:Ethyl acetate (1:1), 40°C/5 h and 1:30 (w/v). The maximum lycopene was extracted using optimized solvent extraction process and had the lycopene content 611.105 mg/100g, purity 81.319%, refractive index 1.37604 and colour value 5.59 L*, 8.00 a*, 6.14 b*. The lycopene content in the extract during storage of 60 days reduced. Storage of lycopene extract at room temperature caused gradual but fast reduction in the lycopene content. There was 53.4% reduction in the lycopene content after 60 days of storage at room temperature. The storage of lycopene extract at refrigerated condition was found safe for maintaining its lycopene content. There was just 2.6% reduction in lycopene content after 60 days of storage at refrigerated condition.



Ruth Mijena
(2013-2015)

PRODUCTION TECHNOLOGY OF SESAME FAT SPREAD



Dr. R. V. Prasad

Abstract

Nut spreads and seed spreads have tremendous advantage for their nutritional value, simplicity and in consumer appeal. Sesame seed possess very good nutritional value, superior quality fat, biologically active components and antioxidants which are health promoting. From the nutritional profile, sesame is categorized among nutraceutical and functional foods. Value addition by developing a product like sesame fat spread makes the nutritional benefits more available and easy to consume for all age groups in different food preparations. The present study was carried out to optimize roasting temperature and time, proportions of food additives, chemical, rheological and organoleptic properties of sesame fat spread and stability of the product. Central composite design (CCD) was used for planning experimental design. Four factors; roasting temperature (180-220°C), roasting time (10-20 min.), sugar (4-6%) and lecithin (0.8-1.2) were selected and evaluated with respect to overall acceptability, texture profile analysis and L*, a*, b* color values. The best combination for product was found to be 180C, 20 min, 7.3% sugar and 1.2% of lecithin. The chemical composition of sesame fat spread was found to be, moisture 0.26±0.03%, protein 27.0±0.6%, crude fat 53.51±2.43%, total carbohydrates 16.31%, crude fiber 13.23±1.4%, ash 3.15±0.02%, phytic acid 4.64±2.32%, oxalic acid 0.73±0.22 mg/100g. The fatty acid profile of sesame fat spread was, palmitic acid 13.31%, palmitolic acid 0.17%, stearic acid 6.57%, oleic acid 40.07%, linoleic acid 37.95%, linolinic acid 0.31%, unknown fatty acids 1.62%. FFA (% oleic acid), peroxide value (meq/kgoil) of the sesame spread was 0.282±0.03 and 0.4±0.01, respectively. More than 50% of sesame spread had particles less than 6.55 µm. The oxidative induction time was 244 h at 22°C. A four weeks storage study at 7 and 22°C was carried out for its sensory, texture profile, L*, a*, b* color values and microbial parameters. Sesame fat spread was found stable and acceptable for 4 weeks at both storage conditions.



Mansi Shah
(2013-2015)

CANNING OF UNRIPE MANGO PANA SQUASH



Dr. A. K. Sharma

Abstract

Unripe mango beverage (*Pana*) is a very popular traditional product prepared and consumed in most households in India as a preventive and curative remedy for sunstroke, bilious, gastrointestinal and blood disorders. Traditional technology is slow, labor intensive, at times unhygienic and results in non-uniform quality of product. The present investigation was undertaken to standardize the pulping parameters for extraction of unripe mango pulp, preparation and thermal processing of canned unripe mango *pana* squash. The effect of pulping and thermal processing parameters for preparation of ready-to-serve beverage from mature unripe cooked mango of *Rajapuri* variety was standardized. A fruit pulper having provision of different sieve size (3.0, 1.6, 1.0 and 0.8 mm) and speed (1050, 1200, 1350 and 1500 RPM) was evaluated for maximum pulp yield. Additives (sugar, salt and cumin powder) and thermal processing (at $90\pm 2^\circ\text{C}$ for 0, 10 and 20 min) for with and without preservative were evaluated with respect to the physicochemical, microbiological and organoleptic quality of the final product. The unripe mango *pana* squash prepared from *Rajapuri* fruits pressure cooked at $103.425\times 10^3 \text{ N/m}^2$ (15 psi) for 15 min, pulped with 1.6 mm sieve size (coarse pulping) and 0.8 mm sieve size (fine pulping) at 1500 RPM, diluted with equal amount of water as pulp and spiced with 40.19% sugar, 2.0% salt and 0.60% cumin powder was found to be highly acceptable. The product when thermally processed at $90\pm 2^\circ\text{C}$ for more than 10 min with and without addition of sodium benzoate as preservative could be safely stored in pre sanitized glass bottles and sterilized retortable pouches for at least two months under an ambient ($32\pm 6^\circ\text{C}$) condition. The standardized technology for the production of canned unripe mango *pana* squash has been suggested for large scale trials and mechanization.



Nirali Christian
(2013-2015)

DEVELOPMENT OF PROTEIN FORTIFIED PUMPKIN BAR



Dr. N. P. Sutar

Abstract

Fruit bars offer tremendous advantages owing to simplicity and lower production cost besides better consumer appeal. Fruit bar is a confectionery product also known as fruit slabs or fruit leather. It was prepared by drying fruit pulp after mixing with appropriate quantities of nutritive sweeteners and other ingredients appropriate to the product and dehydrated to form sheet which can be cut to desired shape and size. A dynamic marketing network can boost this product in India and abroad. Nutritionally, the bar is very low in protein and fat contents. Food enrichment and fortification are the most cost effective and sustainable strategy to address the problem of malnutrition. The present investigation was carried out to optimize different ingredients for production of pumpkin bar, its quality evaluation, shelf life study and cost evaluation. Central composite design (CCD) was used to conduct experiments and optimization was carried out using response surface methodology (RSM). The effect of Whey protein concentrate (0.1-5%), Maltodextrin (0.1-3%), Pectin (0.2-0.6%) and Citric acid (0.3-1.0%) was evaluated with respect to overall acceptability scores (OAA), hardness, stickiness and protein in pumpkin bar. The best solution found with the desirability value of 0.94 having OAA 7.46, Hardness 5.65 N, Stickiness 3.02 N and Protein 14.62% was Whey protein concentrate 5%, Maltodextrin 0.10%, Pectin 0.20% and Citric acid 0.86%. The standardization of cooking (25, 30, 35 °Brix) and drying temperature (60, 70, 80°C) for optimized recipe of pumpkin bar was carried out using a tray dryer. General Factorial design was applied. It was found that 30 °Brix and 70°C were the best conditions for optimized pumpkin bar and it was most acceptable in Sensory attributes, Textural parameters (Hardness, Stickiness), Total drying time and Carotenoid content. Storage study of optimized pumpkin bar was carried out for 90 days at two conditions: 27°C/65% RH and 38°C/90% RH, for that metallized cast polypropylene (MPP) and polyethylene laminate (PE) packaging material was used. During both storage conditions the moisture content, acidity, stickiness and microbial load were found to be increasing, while protein content, pH, carotene content and hardness were decreasing. There was non-significant change in TSS during 27°C/65% RH whereas at 38°C/90% RH storage condition TSS was decreasing. Total production cost of 100 kg of pumpkin bar per day including raw material cost, processing cost, electricity cost and labor cost was estimated to be Rs. 15481.71. The production cost of optimized pumpkin bar was found to be Rs. 154.81/kg.



Nehul Srigod
(2013-2015)

SUPERCRITICAL FLUID EXTRACTION OF ESSENTIAL OIL FROM MINT LEAVES



Dr. R. V. Prasad

Abstract

Mint (*Mentha spicata*) is popular aromatic and annual herb growing in many regions of India. It has specific aromatic odor because of the presence of essential oil, mainly concentrated in leaf. The essential oil is used for various purposes in food and pharmaceutical industry. The present investigation was undertaken to optimize supercritical fluid extraction parameters to obtain superior quality of mint essential oil. The percent moisture, protein, crude fat, crude fibre, carbohydrate, ash etc. in fresh mint leaves were observed to be 81.28, 1.45, 1.95, 6.90, 5.44, 2.98, respectively. The effects of temperature (35, 40, 45, 50 and 55°C), pressure (100, 150, 200, 250 and 300 bar), dynamic time (20, 37.7, 55, 72.5 and 90 min) and particle size (0.2, 0.4, 0.6, 0.8 and 1.0 mm) were evaluated with respect to essential oil yield and carvone content in essential oil. The optimization of supercritical fluid extraction was carried out by central composite design. Optimized conditions for SFE of mint essential oil were 48°C temperature, 151 bar pressure, 0.40 mm particle size and 37.5 min dynamic time. Essential oil extracted at optimized SFE condition had yield of 1.4% and carvone content of 997.82 mg/100g. Essential oil obtained by SFE and hydrodistillation were compared and it was noticed that SFE provided shorter extraction time, higher essential oil yield and higher carvone content than hydrodistillation. The antioxidant activity of essential oil was evaluated for DPPH radical scavenging activity and found comparable to that of BHA. The activity was found to be 71%. Essential oil was evaluated for its antimicrobial activity with four microbial strains. SFE extract of mint leaves showed good antimicrobial activity against *E. coli* and *B. subtilis*. Moderate activity was observed against *S. aureus* and *S. typhi*. The essential oil was encapsulated using extrusion technique. The average particle size of microencapsulated beads was 8.2 µm.



Kalyani Garge
(2013-2015)

EFFECT OF GAMMA IRRADIATION ON COOKING AND NUTRITIONAL CHARACTERISTICS OF PIGEON PEA GRAIN



Dr. D. C. Joshi

Abstract

The present investigation entitled “Effect of gamma irradiation on cooking and nutritional characteristics of pigeon pea grains” was conducted with a broad aim of reducing cooking time and increasing nutritional value of pigeon pea grains by gamma irradiation as pretreatment. Different doses of gamma irradiation was applied to three varieties of pigeon pea grains as a pretreatment having different initial moisture content. Cooking time and leaching loss are positively correlated with the gamma irradiation dose but negatively correlated with the grain initial moisture content. Water absorption capacity and swelling capacity are negatively correlated with cooking time. The minimum cooking time (37 min) and leaching loss (1.6 °B), the maximum water absorption capacity (1.162 g/g of seed) and swelling capacity (2.83 ml/g of seed), the minimum phytic acid content (0.071%) and the maximum *invitro* protein digestibility (80.81%) was observed in BDN-2 variety of pigeon pea grains having 10% (w.b.) moisture content and irradiated at 10 kGy gamma irradiation dose. Gamma irradiation had nonsignificant effect on moisture content of grains, but had significant effect on ash, fat, protein, fibre and carbohydrate content. *Invitro* protein digestibility and *invitro* starch digestibility for cooked grains of BDN-2 variety conditioned at 10% (w.b.) moisture content and 10.0 kGy irradiated increased to 81.39% and 38.59 mg/g of sample, respectively as compared to 57.42 and 14.24 %, respectively for raw untreated uncooked grains. Amino acid content found to be decreased on cooking (148.57 mg/100g) but increased when combined with irradiation (175.27 mg/100g) as compared to raw pigeon pea grains (191.37 mg/100g). The antinutrient constituents of cooked grains of BDN-2 variety irradiated at 10 kGy pigeon pea decreased from 0.417 to 0.071% for phytic acid content, from 1.24 to 0.23 mg/100g for tannin content and from 52.17 to 11.64 mg/100g for trypsin inhibitors when compared with raw grains.



Mangesh Gaikwad
(2013-2015)

DEVELOPMENT OF SLICING AND CUBING MACHINE FOR RAW MANGO



Dr. S. H. Akbari

Abstract

Raw mangoes in India are mostly used as pickles and chutneys. Pickles are prepared in almost every Indian house and also commercially and famous within country. In Gujarat, many households scale pickle manufacturers have expanded in to relatively medium and large-scale units. Most of the raw mango pickle industries of Gujarat perform basic operations like, cutting, slicing, peeling and grating, dicing, and handling manually and in unhygienic ways. All these operations are done manually in the industry and also tedious and labor intensive. So, it is very necessary and important to mechanize these operations by developing machines which can reduce the time as well as cost of operation in more hygienic. Slicing and cube cutting is one of the most important steps in processing of raw mango fruits. Mechanical slicing and cube cutting is capable of more precise than manual mango cutting operation. It reduces the operation time and improves the efficiency and accuracy of raw mango slicing and cube cutting. However, only limited work have been done and published, on the development of slicing and cube cutting machines. Therefore, the present study was undertaken to develop an appropriate, efficient slicer and cube cutter for mechanizing the pickle processing industry. Various physical properties namely; size, shape, unit mass, sphericity and bulk density, and engineering properties namely firmness, of freshly harvested mango fruit of cultivar “Rajapuri” were determined. A slicer based on the principle of manually feeding of mangoes (one by one) was fabricated having capacity of about 500 kg/h. The whole machine was consists of; a) feeding hopper (mangoes to be manually placed), b) cutting unit, c) collecting unit, d) power transmission system and e) frame. The whole machine and all of its components were designed approximately. The cube cutter having the capacity of about 200 kg/h was fabricated with manual feeding of mango slices. The whole machine consist of; a) Feeding hopper (slices are manually fed), b) Rotor, c) Cutting blades, d) Power transmission system, e) outlet and f) frame. The whole machine and all of its components were designed approximately. The performance of developed raw mango slicer and cube cutter was evaluated in terms of slicing and cubing efficiency, capacity, damage percentage and electric consumption. The slicing and cubing efficiency was analyzed on the basis of average weight of the actual fruits sliced. The overall slicing efficiency found to be the maximum 90.39% at 600 rpm with minimum damage percentage (9.60%). The slicing capacity at the maximum overall efficiency was 328.31 kg/h. The cost for slicing of raw mango fruits by developed slicer was estimated to be Rs. 97.66/ton as compared to Rs. 840/ton by manual method. The overall cube cutting efficiency found to be the maximum 82.75% at 160 rpm about with minimum damage percentage (17.19%). The cube cutting capacity at the maximum at 200 rpm was about 106.56 kg/h. The cost for cube cutting of mango slices by developed cube cutter was estimated to be Rs. 91.74/ton as compared to Rs. 1075.20/ton by manual method.



Vivek Saxena
(2013-2015)

PRODUCTION OF HIGH QUALITY CUMIN POWDER USING CRYOGENIC GRINDING



Dr. R. F. Sutar

Abstract

Cumin (*Cuminum cyminum L.*) is an important seed spice and one of the earliest known minor spices used by mankind. The commercial value of seed spices are determined by: color, appearance, taste, pungency, texture, shape, volatile oil content & packaging. Cumin seeds contain numerous phyto-chemicals that are known to have antioxidant, carminative and anti-flatulent properties. The present investigation was undertaken to optimize cryogenic grinding parameters to obtain superior quality of cumin powder. Cumin seeds contained moisture content of $9.3 \pm 0.04\%$, carbohydrate of $35.8 \pm 0.30\%$, protein of $16.5 \pm 0.05\%$, fat of $20.5 \pm 0.23\%$, crude fiber of $11.3 \pm 0.04\%$, ash of $6.6 \pm 0.07\%$ and volatile oil of $3.7 \pm 0.03\%$. The effect of grinding temperature (10, 0, -10, -20 and -30°C), feed rate (5, 6 and 7 kg/h) and sieve size (0.8, 1.0 and 1.5 mm) were evaluated with respect to mean particle size determination, grinding time and volatile oil content. The optimization of cryogenic grinding of cumin was carried out by using completely randomized design. Optimized condition for cryogenic grinding of cumin powder was -30°C temperature, 7 kg/h feed rate, 0.8 mm sieve size. Volatile oil extracted from ground cumin seeds at optimized cryogenic grinding condition had volatile yield of 3.27%. Cuminaldehyde and γ -terpinene content in this sample was found to be 29.61 and 5.36%, respectively. Volatile oil content during ambient grinding and cryogenic grinding were compared. It was observed that during ambient grinding the amount of volatile oil obtained was 2.03% whereas in case of cryogenic grinding the amount of volatile oil content was 3.27% which indicates that in case of cryogenic grinding 62% more volatile oil was obtained as compared to ambient grinding. The cryogenically ground cumin powder was stored at ambient conditions and refrigerated conditions for 90 days. Cumin powder stored at a temperature of ambient conditions showed decrease in volatile oil content by 15.27% whereas volatile oil stored at refrigerated conditions showed decrease in volatile oil content by 7.59%. Changes in volatile oil content at refrigerated conditions were less prominent and retained its quality for 30 days.



Archa Shah
(2014-2016)

CRYOGENIC GRINDING FOR PRODUCTION OF SUPERIOR QUALITY CARDAMOM SEED POWDER



Dr. D. C. Joshi

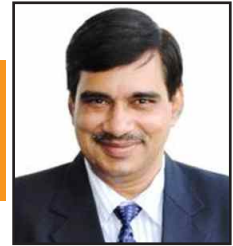
Abstract

Cardamom known as “Queen of Spices” have peculiar aroma and taste due to volatile oil present in it. It contains about 8% volatile oil. The basic cardamom aroma is produced by a combination of the major components, α -terpinyl acetate and 1, 8 cineole and linalool. Grinding is a very important step in the post-harvest processing of spices, requiring special attention in order not to lose the aroma and flavor compounds present in them. During grinding, there is friction between the seeds and grinder, which leads to rise in temperature inside the grinder. The temperature may vary from 42 to 92°C, resulting into loss of volatile content of the species, deterioration of color, and ultimately results in poor quality of the product. It may be desirable to practice grinding at a low temperature. Cryogenic grinding of cardamom seeds using liquid nitrogen was carried out in a laboratory scale cryogenic grinder. The grinding of cardamom seeds took place at the predefined temperatures in the range of -10 to 40°C, having varied feed rate viz. 5, 6 and 7 kg/h. The powder was then passed through the prefixed sieves (0.8, 1.0 and 1.5mm). Results were compared with the grinding without liquid nitrogen. Various observations viz. time of grinding, mean particle size, moisture content of ground powder, volatile oil content of ground powder, 1, 8 cineole content in volatile oil, nitrogen consumed during each treatment and electrical energy consumed during each treatment were recorded. The combination of -40°C feed temperature, 7 kg/h feed rate and 1.5 mm sieve size was found to be best treatment for production of superior quality cardamom seed powder. The application of cryogenic technology for grinding of cardamom seeds has scientifically proved a suitable technique with higher retention of volatile oil content (87.08%) and marker compound (1, 8 Cineole) (80.50%) in cardamom seed powder.



Mayur Chandegara
(2014-2016)

ENERGY ASSESSMENT IN SELECTED BAKERY UNIT



Dr. S. S. Kapdi

Abstract

Energy is a property of objects, transferable among them via fundamental interactions, which can be converted into different forms but not created or destroyed. As energy is the essential input to all economic activities, there is a close connection between the level of energy consumption in a country and its economic development. The present global scenario of energy crisis has forced food processing industry to become more energy conscious. With liberalization of industrial policy, the food processing industry is facing challenges both in terms of quality and plant performance. The operations performed in food processing plants are quite energy intensive, therefore check on energy usage is major concern. In bread manufacturing plant, electricity is the main energy utilized for operation of machineries, such as prime movers and lighting while for baking of bread thermal energy is used. For any industry, a perfect energy assessment being first step to identify and suggest the area of energy wastages and set realistic goals for achievable savings. During the study, preliminary energy assessment was done by carrying out visits to the plant and collection of the past bills available with the plant. The detailed energy assessment was carried out in bread manufacturing plant where in the energy consumed by the unit processes were determined. The total energy consumed in the bread manufacturing plant was 1446.41 kWh per day inclusive of all unit operations. The illuminance level of all the sections were determined. The ILER of the processing section during day hours and night hours were 3.53 and 0.86 which was found to be good. The ILER of the dispatch section during day hours and night hours were 1.08 and 0.30 whereas ILER of micro-batch room was found to be 1.17 and 0.46. The ILER in night hours of dispatch section and micro-batch room were found to be in poor condition and need urgent action. The co-relationship was developed by monitoring the electricity consumption and the product output for the predefined period of time. The specific energy consumption for producing 1 kg of bread was determined. The relationships were developed with electricity, PNG consumption and the product produced. The possible suggestions for conserving energy were made and the reduction in energy consumption would be obtained if the suggestions are accepted and implemented. It was suggested to revise the contract demand of electricity supply from 100 kVA to 90 kVA.



Mohan Naik
(2014-2016)

ASSESSMENT OF SHELF LIFE OF RAW AND PRE-TREATED TOMATO FRUIT UNDER VARIOUS CONDITIONS OF STORAGE



Dr. R. F. Sutar

Abstract

Tomato (*Lycopersicon esculentum*) is a very nutritious and highly perishable climacteric fruit. Hence, there is a need to protect this perishable crop from post-harvest losses and ensure ready availability of the crop to the consumers at affordable prices throughout the year. Thus, the present investigation entitled “Assessment of shelf life of raw and pre-treated tomato fruit under various conditions of storage” was carried out to find out the storability of pre-treated tomato fruits under variable conditions of storage. The experiments were carried out with two different pre-treatments i.e. pre-cooling (hydro-cooling) with three different cooling medium temperatures (4, 6 and 8°C) and edible coating with three different concentration of corn starch viz. 2.5, 5.0, and 7.5%. The pre-treated samples were stored at three different storage conditions i.e. 7, 14°C (85±5% RH) and room temperature (28±2°C). Tomato (CV. Narendra-2) of uniform maturity, harvested at breaker stage was used for the study. During storage, the physico-chemical parameters viz. physiological loss in weight (PLW), texture; firmness, skin resistance, total soluble solids (TSS), pH, titratable acidity (TA), lycopene content and percent spoilage were recorded. It was observed that the time taken during pre-cooling of tomatoes with hydro-cooling at 4, 6 and 8°C cooling medium temperature were 21.53, 23.74 and 27.19 min respectively. The study revealed that hydro-cooling with 4°C took lesser time to reduce the field heat of fruits to desired temperature i.e. 10°C. During edible coating it was observed that the viscosity of coating emulsion increased with increase in concentration of corn starch. 2.5 and 5.0% corn starch coating showed good film formability, whereas 7.5% corn starch coating was brittle in nature. This study revealed that effectiveness of coating materials relatively depended on storage temperature. At all storage conditions 2.5% corn starch shows good preservation effect. It was observed that the PLW of tomato fruit increased in all storage conditions. It was minimum under low temperature storage while maximum under room temperature storage. Minimum change in textural properties were observed in samples stored under low temperature (14 and 7°C). Increase in TSS, pH and lycopene content was relatively higher in tomato stored under room temperature than those under low temperature storage. TA decreased as the storage period increased rapidly under room temperature than low temperature storage (14 and 7°C). Under room temperature storage maximum shelf life of 30 days was obtained for the samples subjected to 8°C hydro-cooling and coated with emulsion containing 2.5% corn starch, which had the advantage of 15 days over control. Combination of hydro-cooling at 8°C, with coating of 2.5% corn starch, stored at 14°C was the best treatment for the extension of shelf life of tomatoes with the advantage of 27 days over control. The maximum shelf life of 18 days was observed for samples subjected to 8°C hydro-cooling. It had an advantage of 9 days over control stored at 7°C storage condition. It was observed that chilling injury was the major problem which caused maximum spoilage at the end of shelf life which is an undesirable condition for storage of tomatoes for longer period of time. The cost of pre-treatment i.e. coating and pre cooling of tomato was estimated to be Rs. 718.4/ton. For storage under 14°C, using solar/PNG/Biogas powered LiBr-Water absorption refrigeration system, the cost of PNG consumption during storage was approximately Rs. 120.42/ton/day.



Riyaz Khorajiya
(2014-2016)

STANDARDIZATION OF PROCESS PARAMETERS FOR THE DEVELOPMENT OF PARTIALLY DEFATTED PEANUT



Dr. S. H. Akbari

Abstract

Peanut (*Arachis hypogaea* Linn) is a source of energy due to its high oil (48-50%) and protein (26-28) contents. In fact, due to its high protein content, it is widely used as an alternative to meat protein, as it contains almost all essential amino acids. Peanut products reduce the cholesterol, lower the risk of heart disease and provide protection against cancer. In addition to the traditional food uses, peanut has also been successfully utilized in supplemented foods such as cookies, bread, breakfast cereals, peanut butter, popular drinks, extenders in meat product formulations, soups and desserts. A solvent extraction method has been commonly used for producing partially defatted peanut. In most of the efficient mechanical extractors, high temperature damages quality of defatted products and is not suitable for human consumption. This can be eliminated by solvent extraction and is an efficient method of oil extraction with less damage to solid. Partially defatted peanut have high protein and low calorie content as a consequence of removal of oil. As a result of this, partially defatted peanut provides fewer calorie with high protein than their conventional counterparts and has grown at a rapid pace. The physical properties of raw peanut seeds (GG-20) were found as length 14.79 ± 1.87 mm, width 8.11 ± 1.11 mm, thickness 7.78 ± 0.93 mm, shape oblong, sphericity 0.65 ± 0.05 , 100 seeds weight 56.73 ± 0.13 g, arithmetic mean diameter 10.09 mm, geometric mean diameter 9.62 mm, surface area 290.96 mm², aspect ratio 54.92%, true density 1.02 ± 0.01 g/cm³, bulk density 0.53 ± 0.02 g/cm³ and porosity 47.36%. Chemical compositions of raw peanut seeds (with skin) and raw peanut seeds (without skin) were found as moisture content 5.61 and 3.5%, protein 23.62 and 24%, crude fat 49.00 and 49.15%, crude fiber 5.45 and 4.62%, total ash 2.21 and 2.34% and carbohydrate 14.11% and 16.39%, respectively. Effect of treatment parameters viz. whole, half and broken peanut seeds (with skin and without skin) and different extraction time (8, 16, 24, 32 and 40 h) were assessed for various sensory attributes viz. color, taste, odor, texture and overall acceptability. Partially defatted peanut seeds were roasted before sensory evaluation to reduce solvent residue. Amongst all the treatment combinations, two viz. partially defatted roasted whole peanut seeds (with skin) defatted at 40 h extraction time and partially defatted roasted broken peanut seeds (without skin) defatted 8 h extraction time showed highest sensory score. Keeping consumer acceptability and market value in priority, partially defatted roasted whole peanut seeds (with skin) and defatted using solvent at 40 h extraction time was standardized and followed by roasting to reduce solvent residue. The protein content of the partially defatted roasted whole peanut (35.87%) was more than the raw peanut (23.62%) and fat remained in defatted peanut seeds after oil extraction was 30.84%. Oil extracted from whole peanut seeds (with skin) at 40 h extraction time had peroxide value 1.92 mEq/kg, acid value 2.07 mgKOH/g and color value ($L^* - 11.44$, $a^* - 2.09$ and $b^* - 8.69$). No solvent residue was found. Partially defatted peanut seeds (with skin) were stored at room temperature in HDPE zip pouch for 60 days. During storage periods, acid value was increased from 2.07 to 3.54 mgKOH/g and negligible effect was found on color value. Sensory score was found more in the partially defatted roasted peanut seeds as compare to that of without roasted peanut seeds.



Ruby Balchandani
(2014-2016)

DEVELOPMENT AND EVALUATION OF BLOOD GLUCOSE LOWERING COMPOSITE FLOUR



Dr. R. V. Prasad

Abstract

The concept of 'multi-grain' atta has taken the consumer market by rage. The present study was undertaken to formulate composite flour (CF) with indigenous grains which lowers the blood glucose levels, is high in protein and other nutrients while being acceptable to the palate. Process flow included optimization of CF followed by preliminary administration to 40 diabetic and 40 non-diabetic subjects to observe the change in blood glucose levels. Subjects were screened on the basis of BMI, BP, HbA1c level and GHQ 12 and counseled regarding their physical and mental well being three months prior to the administration. Diet charts were handed out and they were asked to follow a healthy diet with ample amount of exercise. Independent variables included whole wheat flour (A, 50-53%), textured soy protein flour (B, 15-17%), roasted bengal gram flour (C, 15-18%), barley flour (D, 9-10%), kodo millet flour (E, 5-6%). Protein content (percent), overall acceptability (score out of 9), flavour (score out of 9), texture (score out of 9) were the responses. D-optimal Mixture design was used and the optimized combination was found out to be A- 50%, B- 17%, C- 17.27%, D- 10%, E- 5.73% resulting in 19.65% protein, 7.60 overall acceptability, 7.65 flavour and 7.63 texture. Rotis made from A and CF (optimized combination) was administered to subjects, each composition twice with a gap of 4-5 days, over a period of 21 days. Mixed ANOVA was used to examine the statistical significance of the experimental data. A significant difference was observed between the spikes in blood glucose levels after consuming the rotis made out of A as opposed to the CF irrespective of the physiological condition of the subject. Shelf life studies were perpetrated over a period of 2 months at an interval of 10 days. Peroxide value, acid value and overall acceptability of the composite flour were considered as markers and each one's Coefficient of Variance percentage was found to be low. Rheological studies were realized by Texture Profile Analysis which compared the dough of A and CF. Barring hardness and stiffness, all other factors studied had no significant difference. As the aim is to replace A with CF, these traits would exhibit more acceptability by the consumer.



Sumiran Patel
(2014-2016)

PROCESS DEVELOPMENT OF NUTRI-CEREALS BASED GALACTOGOGUE PRODUCT ENRICHED WITH GARDEN CRESS FOR LACTATING WOMEN



Dr. Samit Datta

Abstract

The present investigation entitled “Process Development of Nutri-Cereals based Galactogogue Product Enriched with Garden cress for Lactating Women” was conducted with an idea to prepare and standardize the process of making nutri-cereals based laddoo. The objectives of the study were to optimize the sprouting conditions and processing parameters, to formulate the multi nutrient laddoo for lactating women and to characterize the final food product for nutritional and quality parameters. Pregnancy and lactation are two states, which need increased nutritional demand like protein, calcium, iron etc. The study is the part of the effort to provide nutritional based foods, that can be more cost effective and health effective for pregnant/lactating women. To cater the elevated demand of nutrition, garden cress and finger millet were selected as major ingredients, being richer sources of calcium and iron. For better nutritional quality, digestibility and organoleptic property, wheat was also selected as major ingredient. The cereals/millet contain certain anti-nutrients like phytic acid, tannin, oxalic acid, total cyanogen and trypsin inhibitor activity, which needed to be reduced. The processing steps like soaking and germination helped to lower anti-nutrient factors and better retention of antioxidants. The best germination time was optimized for the raw materials based upon reduction in the anti-nutrients and increase in the antioxidant levels. The best germination period selected for garden cress was 16 h at 25°C temperature and 90% RH with 34.6% increase in total phenolic content, 48% reduction in total cyanogen and 46% reduction in oxalic acid content. For wheat, the best germination time selected was 76 h at 37°C temperature and 85% RH having 51.25% decrease in phytic acid content and 49.2 per cent reduction in tannin content. While for finger millet, the best germination time selected was 36 h at 37°C temperature at 85% RH having 35.30% decrease in phytic acid content and 29.98% reduction in trypsin inhibitor activity. Roasting of germinated grains reduced the moisture content and enhanced the flavor of the grain. Response surface methodology (RSM) based on Central Composite Rotatable Design (CCRD) at five different levels was adopted for three variables viz. garden cress, wheat and finger millet, to optimize the formulation for multi nutrient laddoo. Optimized product was prepared by mixing germinated and roasted garden cress (5.76 g), wheat (82.51 g) and finger millet (21.52 g) flours with ghee (30%) and sugar (40%) of the total weight of the flour. The optimized product scored 7.34, 7.43, 7.21, 7.36 and 7.38 for color, flavor, texture, taste and overall acceptability, respectively during sensory evaluation based on 9-point hedonic scale. The calcium and iron content in the formulated product was 118.49 mg/100g and 3.93 mg/100g, respectively. The moisture, protein, fat, ash, crude fibre and carbohydrates for final product were 12.06, 14.84, 31.51, 3.04, 3.02 and 35.53%, respectively. The final product was having 144.65, 4.28 and 241 mg/100g of calcium, iron and phosphorus, respectively.



Milan Darji
(2014-2016)

**DEVELOPMENT AND PERFORMANCE EVALUATION OF
CONTINUOUS ROLLING, SHEETING AND CUTTING
SYSTEM FOR MANUFACTURE OF KAJUKATLI**



Dr. A. K. Sharma

Abstract

Traditional products, such as burfi, kalakand, peda, Kajukatli, thabdi, halwasan etc. are not known only for their unique sensory attributes but also the traditional technology that has been associated with them. The preparation methods of kajukatli were studied in detail. The preparation processes involve grinding of soaked kaju, mixing with sugar while cooking, cooling, rolling, sheeting and cutting. All these operations are being carried out manually and reported to be time consuming, unhygienic and produce nonuniform sized and shape of kajukatli. Therefore, an appropriate rolling, sheeting and cutting system was developed and evaluated for continuous production. The developed machine comprised of moving bed, feed plate, rollers for desired sheeting, cutting system and collection tray. Mechanisms for desired speed control and characteristic diamond shape cutting were incorporated for varied capacity. Performance evaluation of the developed machine showed that variation in product size (length, width and thickness), weight, density, textural attributes (fracturability and hardness) were non-significant ($p < 0.05$). The product from the mechanized system were also similar to the fresh manually prepared kajukatli ($p < 0.05$). The machine was observed for handling continuous production from 10 to 80 kg/h by changing its speed 0.1 to 0.7 m/min.



Nilesh Solanki
(2014-2016)

PRESERVATION OF GUAVA PULP USING OHMIC HEATING



Dr. A. Nema

Abstract

Guava (*Psidium guajava* L.) is one of the most tropical fruit, rich in high-profile nutrients with its unique flavour, taste and health-promoting qualities. The guava fruit fits in functional food category, often called 'super fruit'. It is rich in lycopene and ascorbic acid; especially it contains ascorbic acid (100-200 mg/100g) higher than a fresh orange juice (60-80 mg/100ml). Guava has excellent digestive and nutritive value, pleasant flavour, high palatability and availability in abundance at moderate price. Guava pulp is used in preparation of jams, mixed fruit drinks, baby food, confectionary and ice-cream. Conventionally, it is being obtained by washing, peeling, pulping and thermal processing of fully ripened guava fruit at $90\pm 2^{\circ}\text{C}$ for minimum 4 min., for acceptable sterility. Overheating is in general practice to meet the safety requirements. This results in great loss of heat sensitive nutrients. Ohmic heating is considered as a better and promising alternative over the conventional heating process; in which rapid and volumetric uniform heating is possible. Therefore, this study was undertaken with the primary objective of enhancement of shelf life of guava pulp through ohmic heating. Process parameters considered for the study were: voltage (120-180 V), temperature ($70-90^{\circ}\text{C}$) and holding time (2-6 min.) for maximum reduction in enzyme activity and total viable counts, and minimum reduction in ascorbic acid. Factorial design was adopted for the study of effect of these variables on the shelf life of guava pulp and for optimization of the process parameters. . Electrical conductivity of the pulp ranged from 8.5664- 17.8321 mS/cm. The specific heat of the pulp was ranges between 90.3851 to 741.5922 J/kg $^{\circ}\text{C}$. The optimized studied parameters for maximum reduction in total viable count, enzyme activity and maximum retention of ascorbic acid were: 120 V, 90°C and 4 min. for voltage, temperature and holding time, respectively. The optimized results for ascorbic acid, enzyme activity and total viable count were 214.61 mg/100g, 3.11 PE units/g and 2.05 logcfu/ml respectively. The results showed that the ohmically heated processed pulp was stable and acceptable up to ninety days under refrigerated condition at $\pm 7^{\circ}\text{C}$. As compared to ohmically heated pulp the conventionally heated pulp was stable and acceptable upto 60 days under refrigerated condition at $\pm 7^{\circ}\text{C}$.



Janki Patel
(2014-2016)

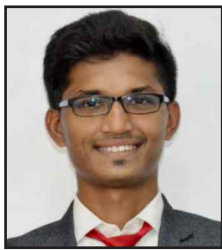
PRODUCTION OF HIGH QUALITY CORIANDER POWDER USING CRYOGENIC GRINDING



Dr. R. F. Sutar

Abstract

Coriander (*Coriandrum sativum* L.) is an annual and herbaceous plant, belonging to the Apiaceae family. Coriander is a culinary and medicinal plant native to southern Europe and western Mediterranean region, and is extensively cultivated worldwide since human antiquity. Coriander is of economic importance since it has been used as flavouring agent in food products, perfumes and cosmetics. Moreover, the essential oils and various extracts from coriander have been shown to possess antibacterial, antioxidant, antidiabetic, anticancerous and antimutagenic activities. Cryogenic grinding is method of powdering products at sub-zero temperature ranges from 0 to -175°C . The present investigation was undertaken to optimize cryogenic grinding parameters to obtain superior quality of coriander powder. Coriander seed contained moisture content $7.72\pm 0.02\%$, carbohydrate content by difference $26.599\pm 0.37\%$, protein content $14.87\pm 0.0092\%$, total fat $16.59\pm 0.35\%$, crude fiber content $29.66\pm 0.07\%$, ash content $3.92\pm 0.05\%$ and volatile oil content $0.641\pm 0.041\%$. The effect of grinding temperature (10, 0, -10 , -20 and -30°C), feed rate (5, 6 and 7kg/hr) and sieve size (0.8, 1.0 and 1.5 mm) were evaluated with respect to grinding time, volatile oil content, linalool content, moisture content, particle size, energy consumption, and nitrogen consumption. The optimization of cryogenic grinding of coriander was carried out using 3 factor completely randomized design. Optimized condition for cryogenic grinding of coriander powder was -30°C temperature, 0.8mm sieve size, 7kg/hr feed rate. Volatile oil extracted at optimized cryogenic grinding condition had volatile oil yield of 0.607%. Linalool 14.8%, geranyl acetate 3.1% and γ -terpinene 0.38% was found in coriander powder volatile oil. This resulted in retention of 93.1% of volatile oil in cryogenically ground powder compared to 20.78% obtained from ambient grinding. The cryogenically stored coriander powder was stored at ambient conditions and refrigerated conditions for 90 days. Coriander powder stored at temperature of ambient conditions showed decreased in volatile oil content from 0.607 to 0.350% and linalool content from 14.8 to 3.2% where as volatile oil and linalool content stored at refrigerated conditions decreased from 0.600 to 0.450% and 14.8 to 4.8%, respectively. Changes in volatile oil content and linalool content at refrigerated conditions were less prominent.



Parth Kuralkar
(2015-2017)

DEVELOPMENT OF PRODUCTION TECHNOLOGY FOR CARROT BASED BLENDED JUICE



Dr. R. R. Gajera

Abstract

Horticultural crops make up a major portion of the diet of humans in many parts of the world and play a significant role in human nutrition, especially as sources of phytonutraceuticals: vitamins (A, C, B1, B6, B9 and E), minerals, dietary fiber and phytochemicals. Carrots contain vitamins such as vitamin C and K, thiamin (B1), riboflavin (B2), pyridoxine (B6) and folates (B9), necessary for metabolism of carbohydrates, proteins and healthy growth. Carotenoids and anthocyanins are the major antioxidant pigments found in carrots. Tomato is a major source of antioxidants, vitamin A, lycopene, folate, vitamin E. Limes are acidic in nature and serve as rich source of vitamin C, citric acid, sugar, certain minerals like calcium and phosphorus. Mint are used for their flavouring and medicinal properties. Experiments were carried out for standardizing the processing and storage parameters for production of carrot based blend juice. Hot inter blanching of carrot slices (5-15 mm thickness) was evaluated for the quality and quantity juice production over a temperature range of 90-100°C and the process was optimized on the basis of the maximum retention of nutrients and the minimum loss in yield of juice. The most effective blanching treatment was 8.50 min at 100°C for 15 mm thick slices. The yield, ascorbic acid contents, pH and TSS of carrot juice were found to be 40.10 %, 4.31 mg/100ml, 6.21 and 6.55 °Brix, respectively. For formulation and blending of juice, optimized blanched juice of carrot was used with tomato, lime and mint extract. Response Surface Methodology (RSM) was used and the blend juice samples were analyzed. Different variables tested were carrot juice, tomato juice, lime juice and mint extract in the range of 50-100, 1-50, 1-15 and 1-10 ml, respectively in response to averaged value of OAA, pH, TSS and ascorbic acid contents of blend juice. The best optimized solution for blend juice was found with the desirability value of 0.91 having ascorbic acid 12.26 mg/100ml, pH 3.79, TSS 5.40 °Brix and OAA 7.55 at 50.12 ml of carrot juice, 50.00 ml of tomato juice, 6.84 ml of lime juice and 8.58 ml of mint extract. Formulated optimized blend juice was hot filled in 200 ml pre-sterilized glass bottles at 85°C, crown corked and thermally processed in hot inter over a temperature range over 80-95°C for 5-20 min. The best thermal process for blend juice was found at 85°C hot filled and processing at 85°C for 20 min and 3.81 pH, 5.41 °Brix TSS, 10.08 mg/100 ml ascorbic acid, 43 cfu/ml total plate counts, 1 cfu/ml yeasts and moulds count, and nil coli form counts of blend juice were obtained. Thermally processed optimized blend juice was subjected for storage at ambient and refrigerated conditions. Most sensory and physicochemical values of optimized blend juice were significant during 90 days storage at ambient (30±2°C) and refrigerated (7±2°C) conditions. Maximum decreased in ascorbic acid in blend juice was 29.83% at ambient and 23.37% at refrigerated condition during storage.



Disha Patel
(2015-2017)

UTILIZATION OF EFFLUENT FROM POTATO PROCESSING PLANT FOR BIOGAS PRODUCTION



Dr. S. S. Kapdi

Abstract

Biogas is a renewable and sustainable secondary energy source generated via biochemical conversion of biomass by a well-known process designated by anaerobic digestion. It provides an alternate source of energy for cooking and lighting in rural areas and manure in the form of biogas spent slurry. The present investigation entitled “Utilization of effluent from potato processing plant for biogas production” was conducted with aim of characterizing the effluent from potato processing plant and optimizing the process parameters for biogas production from the effluent of potato processing plant. In this study, anaerobic co-digestion of cattle dung (CD) and potato effluent (PE) was evaluated to determine the suitable parameters in terms of biogas and methane (CH₄) productions. Batch lab-scale anaerobic co-digestion of CD with PE was conducted at three different total solids (8, 12 and 16%), three temperature levels (25, 35 and 45°C), three mixing ratios (80:20, 60:40, 40:60) at 10, 30 and 50 days HRT in order to obtain maximum biogas yield and methane content. Optimum biogas production parameters from effluent of potato processing plant were determined by Central composite design. The physico-chemical characteristics of the potato processing effluent were determined which had a pH of 7.3, total solids of 16.52%, volatile solids of 43.10%, carbon content of 25%, nitrogen of 0.72%, which had an C:N ratio of 34.44 and starch of 10.12%. The highest biogas yield was obtained was 3110 ml at 12% total solids 45°C temperature, 40:60 co-digestion ratio after 10 days. The highest methane content was found to be 59.67% for the above mentioned treatment only. Optimized condition for biogas production parameters based on the maximum biogas yield and maximum methane content was found out to be at 12% total solids, 45°C temperature, 40:60 co-digestion ratio and 10 days HRT. Based on test results the ii optimum mixing ratio depends on temperature. The slurry was analyzed for its total solids, volatile solids and NPK content and reducing sugar content after 10, 30 and 50 days retention period. The optimized solution had a total reduction of total solids from 12 to 4.21% and the VS were reduced to 17.42% and the reducing sugar content to 0.75%. The NPK values of the optimized digested slurry were also analyzed after 50 days retention period and were found to be 1.99, 0.69 and 0.79%. The C:N ratio was reduced to 5.34.



Axita Patel
(2015-2017)

BIOCONVERSION OF POTATO PROCESSING WASTE TO ETHANOL USING AMYLOLYTIC YEAST



Dr. B. H. Joshi

Abstract

Ethanol is one of the alternative renewable sources of energy with high efficiency and low environmental impact. Various raw materials have been used as carbon sources for ethanol production. Present study was to develop and optimize consolidated bioprocessing to convert the potato processing waste into ethanol using amylolytic strain of *S. cerevisiae* ETGS1. The fermentation variables significantly affecting the bioethanol production were screened out using Plackett-Burman factorial design. These results identified starch concentration, peptone, yeast extract and incubation time as the key determinants to optimize the process, while $MgSO_4$, temperature, pH and inoculum size had a negative effect ($p < 0.05$). The optimized medium composition for maximum ethanol production was obtained by response surface methodology (RSM) based on a Central Composite Design (CCD). Based on results of RSM, a medium consisting PPW having starch concentration 8.5% (i.e. 700 ml effluent mixed with 300 g of gelatinized potato mash), peptone 10 g/l, yeast extract 2 g/l was found optimal and yielded 37.17 g/l of ethanol at 35°C after 84 h of fermentation. The optimized process showed 1.15 fold increase in ethanol yield and 11.5% increase in overall fermentation process efficiency. In conclusion, this study demonstrated that potato processing waste can be used effectively to enhance bioethanol production.



Prachi Umale
(2015-2017)

DEVELOPMENT OF A PORTABLE RIPENING SYSTEM FOR SELECTED FRUITS



Dr. R. F. Sutar

Abstract

The study is aimed to design and fabricate a portable ripening system for ripening of selected fruits. Various aspects were considered while designing the system. Three chambers were designed based on the quantity of fruits, ethephon dose, construction material of the chamber and the orientation of the crates to be placed inside. Mature green banana fruits (cv. Cavendish) were subjected to different concentrations of aqueous solution of ethephon (300, 400, 500 and 600 ppm) for 5 minutes along with control (without ethephon treatment) sample in each chamber. The fruits were wrapped in damp jute cloth and placed in plastic crates. Two crates were kept in the each portable ripening system at ambient condition. Changes in C_2H_4 , CO_2 , temperature and RH conditions were auto monitored and recorded at ambient, no load and loading conditions using sensors connected to data logger. Proximate analysis was carried out on an initial basis. From each chamber, banana fruits were analyzed for physico-chemical and sensory parameters throughout the ripening study. Performance evaluation of all the chambers at different concentrations of ethephon was evaluated on the basis of set quality parameters. The data obtained from the physico-chemical and sensory evaluation were subjected to statistical analysis for optimization of the system design. The results showed that ripening process increased with increase in the concentration of ethephon dosage (300-600 ppm) and with the duration for which the fruits were kept for ripening. The physical parameters such as pulp to peel ratio, PLW and chemical parameters such as TSS, titrable acidity, reducing sugars and total sugars increased whereas pH and non-reducing sugars experienced a decline with increasing concentrations of ethephon dosages due to ripening of banana fruits. The colour values did not show much changes with the increase in ethephon dosages as the colour development was retarded in banana due to high temperature and RH conditions. The ethephon treated fruits registered adequate firmness as compared to control samples. The ethephon treatment of 600 ppm on banana fruits inside the chamber having dimension of 1220 mm x 460 mm x 360 mm was found to be optimum for ripening of banana fruits. Cost of fabrication of the optimized portable ripening system was calculated as Rs.1920/-.



Bhavika Rabari
(2015-2017)

**EFFECT OF GAMMA IRRADIATION ON MICROBIAL AND
CHEMICAL QUALITY OF WHOLE AND POWDERED
DRIED RED CHILLI**



Dr. A. K. Sharma

Abstract

The present investigation entitled “Effect of gamma irradiation on microbial and chemical quality of whole and powdered dried red chilli”. This study evaluated the efficacy of gamma irradiation to inactivate *Aspergillus flavus* in a dried red chilli samples. Different doses of gamma irradiation was applied to two varieties and forms of dried red chilli having different initial moisture content. *Aspergillus flavus* populations decreased with increasing treatment doses. D10-value of fungi *Aspergillus flavus* showed more resistant to gamma irradiation than *Rhizopus*, *Helminthosporium*, *A. niger* and *Fusarium sp.* Gamma irradiation dose of 7.5 kGy was effective in eliminating *Aspergillus flavus* populations by 6 log cfu/g in the samples with minimal change in colour and capsaicin content. During gamma irradiation treatment ΔE colour value and capsaicin content were not significantly changed. Two varieties and forms of dried red chillies in LDPE bags (300gauge) irradiated to doses of 0 (control), 2.5, 5.0, 7.5, 10.0 kGy and inactivation of *Aspergillus flavus*, color change and capsaicin content were estimated periodically during storage up to 6 months at ambient condition. During storage reduction in the counts in irradiated and increase in the counts in unirradiated samples were found. However, significant but slight change in colour change (ΔE) from 0.65 to 1.25 and capsaicin 224.23 to 226.64 mg/100g were observed for all the dried red chilli samples.



Devansh Desai
(2015-2017)

EFFECT OF GAMMA IRRADIATION ON SHELF LIFE OF TOMATO



Dr. D. C. Joshi

Abstract

The present investigation entitled “Effect of Gamma Irradiation on shelf Life of Tomato” was conducted with a broad aim of increasing the shelf life of tomatoes using gamma irradiation as a pretreatment. Tomatoes (Anand Tomato-3) at two different maturity stages i.e. breaker and light red stage were exposed to different levels of gamma irradiation (1, 2, 3 and 4 kGy). Other preservation pretreatments like, hydro precooling (8°C) and edible coating (2.5% w/v corn starch) were also used in combination with gamma irradiation to further enhance the shelf life of tomato fruits. After pretreatments, tomatoes were stored at two different storage temperatures i.e. 28±1 and 14±1°C. All the pretreated tomatoes were evaluated for its physical characteristics (physiological loss in weight, firmness, skin resistance, color and spoilage), chemical characteristics (titratable acidity, total soluble solids and lycopene content), microbial characteristics (total plate count and yeast & mold count) and shelf life. For tomatoes having breaker stage maturity, gamma irradiation at increasing dose levels had resulted in significantly lower physiological loss in weight, higher firmness, higher skin resistance, lower “a” value of color, lower spoilage, higher titratable acidity, lower total soluble solids, lower lycopene content, lower total plate count and lower yeast and mold count during storage. While for light red stage tomatoes, gamma irradiation at increasing dose levels had resulted in significantly higher physiological loss in weight, lower firmness, lower skin resistance, higher “a” value of color, higher spoilage, lower titratable acidity, higher total soluble solids, higher lycopene content, lower total plate count and lower yeast and mold count during storage. Tomatoes stored at 14±1°C had lower physiological loss in weight, higher firmness, higher skin resistance, lower “a” value of color, lower spoilage, higher titratable acidity, lower total soluble solids, lower lycopene content, lower total plate count and lower yeast and mold count as compared to tomatoes stored at 28±1°C during the entire storage period. Tomatoes stored at 14±1°C had higher shelf life as compared to tomatoes stored at 28±1°C during the entire storage period. Breaker stage tomatoes treated with 4 kGy and stored at 14±1°C dose showed 150% increase in shelf life as compared to control tomatoes. Breaker stage hydro precooled tomatoes treated with 4 kGy and stored at 14±1°C dose showed 154% increase in shelf life as compared to control tomatoes. Breaker stage coated tomatoes treated with 4 kGy and stored at 14±1°C dose showed 150% increase in shelf life as compared to control tomatoes. Breaker stage hydro precooled and coated tomatoes treated with 4 kGy and stored at 14±1°C dose showed 170% increase in shelf life as compared to control tomatoes.



Ankita Jadhav
(2015-2017)

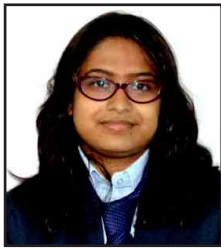
STANDARDIZATION OF DRYING TECHNIQUE AND EXTRACTION OF BIOACTIVE COMPOUND FROM MORINGA OLEIFERA LEAVES



Dr. S. H. Akbari

Abstract

Moringa oleifera is the most widely cultivated species of a monogeneric family, the Moringaceae. Moringa is especially promising as a food source in the tropics because the tree is in full of leaf at the end of the dry season when other foods are typically scarce. Drying/dehydration are the technique by which shelf life of the leaves can be enhanced. Also, the extract of leaves can be used either in different food products as ingredient or medicinal purpose. Successful drying and extraction techniques of the leaves make availability of antioxidants and other vitamins for formulating health supplements. Supercritical fluid extraction (SFE) has emerged as a highly promising environmentally benign technology for selectively recovering thermally labile bioactive ingredients from natural sources. The nutraceutical produced by SFE using carbon dioxide (CO₂) at near-ambient temperatures are preferred by consumers due to their superior quality and higher bioactivity without the problems of residual solvent and microbial contamination. The effects of Vacuum and Fluidized bed drying on different drying temperature (45, 55, 65, and 75°C) on beta carotene and vitamin C retention in Moringa leaves were evaluated. The dried Moringa leaves produced using standardized drying technique was used for optimization of supercritical fluid extraction processing parameters (temperature, pressure and static time) on the basis of yield of extract and yield of beta carotene extracted. Yield of beta carotene was determined using HPLC. The optimized extract containing beta carotene was studied for its shelf life for 60 days at different storage conditions. The leaves dried at 45°C temperature in Vacuum dryer had the maximum beta carotene content (26.98 mg/100g) and vitamin C (186.63 mg/100g) content retention while the leaves dried at 75°C in Fluidized bed dryer had the minimum beta carotene content (14.06 mg/100g) and vitamin C content (61.06 mg/100g). The maximum yield of extract (9.028 g/100g) was found using SFE when operated at 80°C temperature, 40 MPa pressure and 180 min static time. The minimum yield of extract (1.952 g/100g) was found at 80°C temperature, 20 MPa pressure, 60 min. The maximum yield of beta carotene (11.3225 mg/100g) was found at the combination of 40°C temperature, 20 MPa pressure and 60 min static time. The minimum yield of beta carotene (2.047 mg/100g) was obtained at 80°C temperature, 20 MPa pressure, 60 min static time. Storage of extracted beta carotene at 30±2°C caused gradual but fast reduction in the purity of beta carotene. Storage of beta carotene at -18°C temperature was found safe for maintaining its purity till 60 days.



Bijal Thakkar
(2016-2018)

HOT WATER TREATMENT OF UNRIPE BANANA TO EXTEND THE SHELF LIFE



Dr. V. B. Bhalodiya

Abstract

Banana is the main fruit in international trade and most popular in the world. In terms of volume, they are ranked first among the exported fruit but the banana is highly perishable fruit as well, so to increase the shelf life of banana two experiments were done. In first experiment the bananas were subjected to hot water treatment (HWT) for different time and temperature. The fruits were treated in hot water bath for the hot water treatment of 45, 50 and 55°C temperature for 5, 10 and 15 min., respectively. Control sample was also taken to see the difference between treated and untreated bananas. The experiment consisted of 30 treatment combinations and for each treatment laid out in completely randomized design under factorial concept with three repetitions. In second experiment the optimized hot water treatment was combined with per acetic acid treatment for 2 min. Per acetic acid (PAA) is a strong disinfectant with a wide spectrum of antimicrobial activity. Per acetic acid is commonly used as a disinfectant in food, beverage and paper industry. There were four concentrations of per acetic acid viz. 10, 50, 100 and 150 ppm. Each banana was firstly treated with optimized hot water treatment and then per acetic acid treatment. For both the experiments physico-chemical parameters like Color, Firmness, Physiological weight loss, pulp to peel ratio, spoilage, pH, titratable acidity, total soluble solids and shelf life were measured. It was concluded that hot water treatment at 50°C for 5 min increased the shelf life of banana by 10 days whereas the untreated sample had shelf life of 4 days. The physic-chemical parameters were also found with significant good results when bananas were dipped in hot water bath. The water to fruit ratio was taken as 3:1. Hot water treatment perhaps retarded the physiological and biological activities and finally led to the higher shelf-life. The increase in shelf life was probably due to the reduction of various gases (O₂, CO₂) exchange of inner and outer atmosphere as well as slowing down the process leading to the ripening by different treatments. The combined effect of hot water and per acetic treatment was better than individual hot water treatment. The optimized hot water treatment viz. 50°C for 5 min was taken as pre-treatment before applying this chemical treatment of per acetic acid. The combined effect of hot water treatment and per acetic acid treatment increased the shelf life of banana by 14 days, whereas the hot water treatment increased the shelf life of fruits of 10 days. In combined effect per acetic acid showed the best result in 150 ppm concentration among the four treatments. Physico-chemical parameters measured for this treatment were same as hot water treatment. The combination of per acetic acid and hot water treatment was effective on the present investigation.



Vinodchandra Prajapati
(2016-2018)

DEVELOPMENT OF TECHNOLOGY FOR BOTTLE GOURD JUICE BASED CARBONATED BEVERAGE



Dr. R. R. Gajera

Abstract

Experiments were carried out for standardizing the processing and storage parameters for production of bottle gourd juice based carbonated beverage. Central composite design (CCD) and response surface methodology (RSM) were used to formulate and analyze the formulated beverage samples. Different variables tested were bottle gourd, pineapple, lime and sugar syrup in the range of 10-20, 1-10, 1-5 and 10-90 ml, respectively in response to averaged value of pH, acidity, TSS, ascorbic acid and OAA contents of formulated beverage. The best optimized solution for formulated beverage was found with the desirability value of 0.91 having pH 3.04, TSS 15 °Brix, acidity 0.34%, ascorbic acid 2.86 mg/100g and OAA 7.80 at 12.50 ml of bottle gourd juice, 3.29 ml of pineapple juice, 4 ml of lime juice and 69.69 ml of sugar syrup. Validation of the optimum solution was also done by conducting the experiment. Optimized formulation as above was subjected to thermal treatment (T1) i.e. beverage was cooled at 4°C and filled in 250 ml plastic bottles, treatment (T2) i.e. beverage was at 37°C and filled in 250 ml plastic bottles, treatment (T3) i.e. beverage was heated at 95°C and cooled at 4°C then filled in 250 ml plastic bottles, treatment (T4) i.e. beverage was heated at 95°C and cooled at 37°C then filled in 250 ml plastic bottles. Carbonation was carried out at 80, 100, 120 psi pressure and all bottles were capped and was analyzed. The best process for carbonated beverage, heated at 95°C and cool down at 4°C followed by carbonation at 120 psi pressure was found the optimum. At this temperature and carbonation pressure combination, 3.35 pH, 15 °Brix TSS, 0.4% acidity, 2.16 mg/100g ascorbic acid, 46 cfu/ml total plate counts, 1 cfu/ml yeasts and mold count, and nil coli form counts of carbonated beverage were obtained. Thermally processed optimized carbonated beverage was evaluated for its quality characteristics during ambient (30±2°C) and refrigerated (7±2°C) storage for 90 days. However, P<0.05 was found for sensory and physicochemical and microbiological values at the end of 90 days storage. Maximum decreased in ascorbic acid in carbonated beverage was 19.90% at ambient and 19.45% at refrigerated condition, during 90 days storage. The total plate count were decreased from 46 to 12 cfu/ml and 8 cfu/ml for ambient and refrigerated storage condition, respectively. Hence the produce beverage satisfies microbiological quality and was safe up to 90 days storage.



Kinjalben Rana
(2016-2018)

EFFECT OF LOW FREQUENCY OHMIC HEATING ON CARROT JUICE RECOVERY AND ITS SHELF LIFE



Dr. A. Nema

Abstract

The carrot has been called the “poor man's ginseng” as it contains more than 490 phyto-chemicals (plant or fruit derived chemical compounds). It is an excellent nutritive food as it is rich source of α - and β - carotene. Investigations were carried out to study the effects of low frequency ohmic heating on carrot juice recovery and its shelf life over a temperature range of 70-90°C. The study was designed using full factorial design. The electrical conductivity and specific heat of carrot slices were in the range of 0.03-0.44 mS/cm and 5.72-66.60 kJ/kg°C, respectively at 40-90°C temperature range. The independent variables selected were 10-30 Hz frequency, 70-90°C temperature and 2-6 min. holding time for optimization of process parameters for maximum juice recovery and maximum β -carotene content. The highest juice recovery, 23.20% over control was observed at 30 Hz frequency, 80°C temperature and 6 min. holding time. Standardization for maximum shelf life was carried at three levels of independent variables i.e. 2-6 Hz frequency, 70-90°C temperature and 2-6 min. holding time. Optimization was carried out on the basis of minimum standard plate counts (SPC) and maximum β -carotene content. The best optimized solution for maximum shelf life was at 6 Hz frequency, 90°C temperature and 6 min. holding time. At this optimized condition, SPC and β -carotene content were found to be 1.41 log cfu/ml and 40.06 μ g/100g, respectively. The results showed that the ohmically heated processed carrot juice was stable and acceptable up to 28 days under refrigerated condition (7 \pm 2°C). As compared to ohmically heated carrot juice the conventionally heated carrot juice was stable and acceptable up to 14 days under refrigerated condition (7 \pm 2°C). Whereas, at ambient storage condition (30 \pm 2°C) the carrot juice was totally spoiled within 7 days of storage.



Vidhi Vaja
(2016-2018)

DECONTAMINATION OF PESTICIDE RESIDUES FROM TOMATO AND CHILLI AND ITS SHELF-LIFE



Dr. S. H. Akbari

Abstract

In order to generate field level contamination of the insecticides (Profenophos, Ethion, Triazophos and Acephate) under study on tomato and chilli, control plots of these vegetables were sprayed with the mixture of the pesticides at double the recommended dose. The vegetables were harvested 24 h after the spray, the vegetables were immediately subjected to residues analysis to know the initial levels and also were subjected to four different treatments e.g. dipping in fresh water, dipping in 2% brine solution, dipping in 0.5% acetic acid, dipping in ozonized water and also for the microbial and physical analysis. In Tomato, dipping in 2% brine solution for 15 min was found the most effective treatment resulting reduction of Profenophos, Ethion, Triazophos and Acephate up to 40.97%. Total plate count (TPC) were found less in ozone, 2% Brine and 0.5% Acetic acid treatments i.e. 3.2, 3.6 and 3.5 logcfu/g respectively as compare to fresh water treatment. During shelf life study of tomato, minimum physical loss in weight (38.92%) and spoilage percent (26.67%) were observed in ozone treated sample up to 24 days of storage. Ozone treated sample was observed free from decay during entire storage period and maximum changes in physical loss in weight (18.65 %) and spoilage percent (30%) was observed in 0.5% Acetic acid treated sample on 15 day of storage life. Microbial parameters like, TPC and yeast and mold were found minimum in ozone treated tomato i.e. 8.0 and 9.1 log cfu/g on 21 and 24 day of storage period respectively. Maximum TPC (7.8 log cfu/g) was found in 2% brine treated sample on 15 day of storage period. In chilli, dipping in 2% brine solution for 15 min was found the most effective treatment resulting reduction of Profenophos, Ethion, Triazophos and Acephate up to 44.34% and dipping in fresh water for 15 min was found least effective treatment for reduction pesticide residues which was observed up to 24.09%. Microbial parameters like, TPC were found less in ozone, 2% Brine and 0.5% Acetic acid treated sample i.e. 3.9, 4.3 and 4.6 log cfu/g, respectively. Yeast and mold in the Chilli were found absent in ozone and 2% brine treatments during initial 3 days of storage period while in 0.5% Acetic acid treatment, it was found present. In fresh water treatment, TPC and yeast and mold were observed higher in chilli sample as compared to the other treatments. Hence, 3 treatments i.e. Ozone, 2% Brine and 0.5% Acetic acid treatment were continued for shelf life study. During shelf life study, minimum change in PLW (20.83%) and spoilage percent (47.14%) were observed in ozone treated chilli on 15 days of storage. Ozone treated chilli was observed free from decay during entire storage period. Maximum changes in PLW (16.95%) and spoilage (54.29%) in chilli was observed in 2% Brine treatment on 12 day of storage life. Microbial parameters like TPC and yeast and mold were found minimum in ozone treated Chilli i.e. 8.2 and 9.8 log cfu/g on 12 and 15 day of storage period, respectively. Maximum TPC was found in 2% brine treatment (9.8 log cfu/g) on 12 day of storage period.



Monika Bhoi
(2016-2018)

TECHNOLOGY FOR PRODUCTION OF SUPERIOR QUALITY CINNAMON BARK POWDER AND ESSENTIAL OIL USING CRYOGENIC GRINDING AND SUPER CRITICAL FLUID EXTRACTION



Dr. R. F. Sutar

Abstract

Cinnamomum zeylanicum is an evergreen tropical tree, the inner bark of the tree of *Cinnamomum verum* (*Cinnamomum Zeylanicum*) and it is belonging to the “Lauraceae” family. Cinnamon Bark is one of the well-known, oldest and most flavor filled spices. Cinnamon Bark is considered a remedy for respiratory, digestive and gynecological ailments and also as ayurvedic medicine. Its essential oils and various extracts from cinnamon bark have been shown to possess various antibacterial, antioxidants, anti-diabetic, anti-cancerous and anti-inflammation activities. Cryogenic grinding is method of powdering products at sub-zero temperature ranges from 0 to -194°C . In Cryogenic technology, the liquid nitrogen provides the refrigeration needed to precool the spices and maintain the desired low temperature by absorbing the heat generated during the grinding operation. Super critical fluid extraction (SFE) has emerged as a highly promising environmentally benign technology for selectively recovering thermally labile bioactive ingredients from natural sources. The nutraceutical produced by SFE using carbon dioxide (CO_2) at near-ambient temperatures are preferred by consumers due to their superior quality and higher bioactivity without the problems of residual solvent and microbial contamination. The present investigation was undertaken to optimize cryogenic grinding parameters to obtain superior quality of cinnamon bark powder and for extraction of essential oil by supercritical fluid extraction technology. Cinnamon is long stick with mean length, width and thickness of 61 mm, 12.59 mm, and 2.65 mm, respectively. Cinnamon bark contained moisture content $5.1 \pm 0.02\%$, carbohydrate content by difference $52 \pm 0.37\%$, protein content $3.5 \pm 0.0092\%$, total fat $4 \pm 0.35\%$, crude fiber content $33. \pm 0.07\%$, ash content $2.4 \pm 0.05\%$ and volatile oil content $3.5 \pm 0.041\%$. The effect of grinding temperature (0, -20, -40, -60, -80 and -100°C), feed rate (8, 9 and 10 kg/hr) and sieve size (0.8, 1.0 and 1.5 mm) were evaluated with respect to grinding time, volatile oil content, particle size, energy consumption, and liquid nitrogen consumption. The optimization of cryogenic grinding of cinnamon bark was carried out using three factorial Completely Randomized Design. Optimized condition for cryogenic grinding of cinnamon bark powder was -80°C temperature, 0.8mm sieve size, 10 kg/hr feed rate. Volatile oil extracted at optimized cryogenic grinding condition had volatile oil yield of 3.01%. Volatile oil content during ambient grinding and cryogenic grinding were compared, which indicated in retention of 88.23% of volatile oil in cryogenically grounded powder compared to 33.11% obtained from ambient grinding. Optimized cryoground cinnamon bark powder was further subjected to supercritical fluid extraction technology. The effects of temperature (40, 55 and 70°C), pressure (100, 200 and 300 bar) and dynamic time (30, 60 and 90 min) were evaluated with respect to the yield of essential oil, cinnamaldehyde and eugenol content in extract. The optimization of supercritical fluid extraction was carried out by using Central Composite Design. Optimized condition for supercritical fluid extraction of essential oil extract was 70°C temperature, 283 bar pressure and 68 min of dynamic time. Essential oil extracted at optimized SFE condition had yield of 8.72%, along with active components like cinnamaldehyde and eugenol 11689 and 190 mg/100g, respectively.



Nirav Tejani
(2016-2018)

EFFECT OF GAMMA RADIATION ON STORAGE OF PEANUT AND SESAME



Dr. A. K. Sharma

Abstract

Peanut and sesame are semi-perishable and are subject to quality losses during storage through insect and rodent infestation, fungal development, flavour changes, rancidity, etc. High moisture and temperature regulates the rate of deterioration during storage. Absence of insect, rancidity and aflatoxin are major criteria used to determine quality of stored oilseeds. Gamma (γ) radiation is recognized as a techno-commercially feasible method for reducing postharvest food losses, ensuring the hygienic quality and preservation of food, extending its shelf life and facilitating wider trade. There was no study on effect of gamma (γ) irradiation on Gujarat variety of peanut and sesame seeds. Therefore, present study was planned with the broad aim of study the effect of gamma irradiation dose (2.5, 5.0, 7.5 and 10.0 kGy) and storage (in sealed in 40 μ pp bags) period up to 6 months on peanut (GG-20) and sesame (GT-2) seed and its oil quality. Physico-chemical and sensory attributes of the selected oilseeds were evaluated before and after irradiation and during storage. Samples were periodically evaluated at every 15 days interval for physico-chemical analysis of peanut and sesame seeds and their oils quality. Effect of gamma irradiation doses was significant ($p < 0.05$) on a) moisture and oil content of the oilseeds, b) acid, iodine and peroxide values of the extracted oils. While effect was non-significant ($p > 0.05$) on a) protein and ash content, b) sensory attributes of oilseeds, and c) physical attributes of oils such as refractive index and color value. Change in fatty acid profile was significant due to irradiation and linolenic fatty acid disappeared in the peanut oil. The unsaturated fatty acids of peanut and sesame oil were slightly decreased and saturated fatty acids were slightly increased with increase in gamma radiation doses. Effect of storage period was more pronounced in the moisture and oil content of oilseeds. However, slight decrease in oil content was also observed due to increase in irradiation dose. Acid value and peroxide value of peanut and sesame extracted oils were significantly increased and iodine value was significantly decreased with increase in gamma radiation doses and storage days. Insect infestation was observed in the nonirradiated control samples. However, irradiated samples were free from total plate count, yeast and mould, aflatoxin and insects during the storage period of 180 days, which were otherwise present in the raw and control samples.



Avanee Macwan
(2016-2018)

EVALUATION OF TRANS FATTY ACIDS AND ACRYLAMIDE IN SELECTED INDIAN ETHNIC FOODS



Dr. Samit Datta

Abstract

Food contains a wide range of natural chemical compounds, some of which are nutritive and nonnutritive compound. Some of these compounds may even act as anti-nutritional factors, interfering with the utilization of some of the nutrients present in these foods, while others may be potentially toxic, resulting in illness and death, if consumed in large quantities. The current research work entitled “Evaluation of trans fatty acids and acrylamide in selected Indian ethnic foods” comprising a set of three objectives was conducted with a broad aim of checking the quality of Shing bhujia, Potato wafer, Aloo bhujia, Bhakharvadi, Gulab jamun, Ghari, Motichur laddoo, Khari, Nankhatai. In this investigation, proximate composition of selected food products was carried out for evaluating nutritional quality of the selected food products. Proximate analysis showed that moisture content was maximum in Gulab jamun and minimum in Aloo bhujia, fat content was maximum in Aloo bhujia and minimum in Gulab jamun, carbohydrate content was maximum in Gulab jammun and minimum in Shing bhujia, ash was maximum in one brand of Aloo bhujia and minimum in one brand of Khari, protein was maximum in Shing bhujia and minimum in Khari, fiber was maximum in Bhakharvadi and minimum in Gulab jamun. The fat extracted from all the products was used for evaluation of peroxide value, anisidine value, TOTOX value, acid value and iodine value. The results of peroxide value and TOTOX value show the stage of oxidation of all the samples, from where most of the sample values is in the range of codex standard for oil from vegetable source and Global Organization for EPA and DHA omega-3s (GOED) limit, respectively. Iodine values obtained for various products indicated degree of unsaturation of fat. Saturated fats in general have long been shown to contribute to chronic diseases such as cardiovascular disease, cancer, and obesity. Unsaturated fat is healthy fat because have vitamins A, D and E. The fatty acid profiling revealed that saturated fat content was maximum in one brand of Nanakhatai and minimum in Gulab jamun. The unsaturated fat content was maximum in Shing bhujia and minimum in Gulab jamun. Evaluation of trans fatty acid is important because it leads to cardio vascular disease (CVD) or coronary heart disease (CHD). Food safety standards authority of India (FSSAI) limits for trans fat in vanaspati/margarine to below 2% to say that product is free from trans fat. It was observed that out of all selected products only Ghari, Motichur laddoo, Khari and Nankhatai contained trans fatty acid (0.11 to 3.30%). In fried and baked foods, besides saturated and trans fatty acid, acrylamide formation is another area of growing concern. Acrylamide is a chemical compound naturally formed during maillard reaction between sugars and amino acids. In 1994, the International Agency for Research on Cancer (IARC) classified acrylamide as a potential carcinogen to humans (Group 2A) based on the carcinogenicity of acrylamide in rodents. During the study of acrylamide effects on health on rodents body, scientist gets the result that acrylamide act as carcinogen in rodents, also it is a suspected a carcinogen in humans causing gene mutation and DNA damage. It is probably always been present in cooked foods and cigarette smoke. It was found that all the selected food samples contained varying amount of acrylamide (0.08 to 52.17 µg/kg).



Ameer Macwan
(2016-2018)

EVALUATION OF COMBINED EFFECT OF GAMMA IRRADIATION AND EDIBLE COATING ON SHELF LIFE OF SAPOTA FRUIT



Dr. B. H. Joshi

Abstract

Sapota fruits delicious and medicinally important fruits, cultivated though out the tropical climate countries. Due to highly perishable in nature and fast ripening process, it has short post-harvest life. To enhance the shelf life of sapota fruit post-harvest interventions are necessary. The research work entitled “Evaluation of combined effect of gamma irradiation and edible coating on shelf life of sapota fruits” comprising a set of three experiments was conducted with a broad aim of increasing shelf life of sapota fruits at ambient temperature. The results of the experiments showed that among edible coating, pectin, polyvinyl alcohol, glycerol coated sapota fruits recorded lower physiological loss in weight (18.51%), firmness (0.16 N) and thereby increased shelf life (11 days) of sapota and proved to be the best. It was observed that the physiological loss in weight and spoilage trough out the storage period were significant less compared to the other edible coating formulation. Among the gamma irradiation treatments, lower dose at 0.30 kGy recorded lower physiological loss in weight (15.61%), higher firmness (0.19 N), and thereby recorded higher shelf life (10 days). The combination treatment of pectin, polyvinyl alcohol, glycerol coated sapota fruits followed by gamma irradiation dose of 0.3, 0.4 kGy enhanced the shelf life up to 13 days. The fruits treated with pectin, polyvinyl alcohol, glycerol coated sapota fruits followed by 0.4 kGy gamma irradiation dose found to be best and It showed higher firmness (0.20 N), total soluble solids (27.15 °B), ascorbic acid (8.82 mg/100g) and Low respiration rate (9.42 ml(CO₂) Kg⁻¹h⁻¹), physiological loss in weight (19.85%). Combination of edible coating with low dose gamma irradiation effect significantly to sapota fruit and facilitating shelf life to sapota fruit; there by benefitting the growers and consumers.



Utpal Patel
(2016-2018)

TECHNOLOGY FOR PRODUCTION OF SUPERIOR QUALITY BLACK PEPPER POWDER AND ESSENTIAL OIL USING CRYOGENIC GRINDING AND SUPERCRITICAL FLUID EXTRACTION



Dr. R. V. Prasad

Abstract

India is considered as home of spices and black pepper (*Piper nigrum* L.) is called king of spices. Spices are used to improve flavor and taste of food products and generally ground before use. In a normal grinding process, heat is generated when energy is used to fracture the particles and spices lose some of their essential oil or flavoring components due to the temperature rise. Therefore, cooling of spices at low temperature with liquid nitrogen before feeding to the grinder and maintaining the low temperature in the grinding zone can significantly help in retention of essential oils. The physical properties; size, bulk density, coefficient of friction and angle of repose of black pepper were observed to be 5.05 ± 0.63 mm, 550 ± 50 kg/m³, 0.49 ± 0.15 , $38 \pm 0.26^\circ$. The chemical properties; moisture, fat, protein, fiber, ash, carbohydrate and essential oil were observed to be 12.04 ± 0.29 , 8.12 ± 0.28 , 12.25 ± 0.08 , 16.81 ± 0.41 , 3.50 ± 0.31 , 47.28 ± 1 and $4.88 \pm 0.1\%$, respectively. Optimization of cryogenic grinding of black pepper was carried out with respect to grinding time, liquid nitrogen consumption and essential oil yield. The effect of grinding temperature (0 to -100°C), feed rate (8, 9 and 10 kg/h) and sieve size (0.8, 1 and 1.5 mm) were studied with three factorial complete randomized design. The optimized conditions for cryogenic grinding were -52°C temperature, 10 kg/h feed rate and 1.5 mm sieve size. The essential oil extracted from black pepper was 3.36%. Black pepper powder was further evaluated for extraction of essential oil in supercritical fluid extraction. Response surface methodology (RSM) was used for optimization to determine effects of temperature (20, 30, 40, 50 and 60°C), pressure (100, 150, 200, 250 and 300 bar), dynamic time (30, 60, 90, 120 and 150 min) and static time (30, 45, 60, 75 and 90 min) with respect to extract yield and piperine content. The optimized conditions observed were 47°C temperature, 245 bar pressure, 130 min dynamic time and 30 min static time. The extract yield and piperine obtained at optimized conditions were 5.61% and 1259 mg/100g, respectively.



Nilesh Sardar
(2016-2018)

SUPERCritical FLUID EXTRACTION OF ESSENTIAL OIL FROM CRYOGROUND AJWAIN SEED



Dr. R. V. Prasad

Abstract

Seed spices have been known for ages as effective therapeutic foods. The capacity of spices to impart biological activity is now emerging as an area of interest for human health. Ajwain (*Trachyspermum ammi* L.) is an important seed spice that belongs to family Apiaceae. Seed are small, oval and ridged shape greyish brown in color. Its characteristic odor and taste due to presence of an essential oil (2.5-5%). Grinding is a very important step in the post-harvest processing of spices requiring special attention in order not to lose the aroma and flavor compounds present in them. The temperature may in grinding vary resulting into loss of essential content of the species. Cryogenic grinding of ajwain seeds using liquid nitrogen was carried out in laboratory scale cryogenic grinder. The grinding took place at the predefined temperatures in the range of 0 to -100°C, having varied feed rate viz. 8, 9 and 10 kg/h and passed through the prefixed sieves (0.8 and 1.0 mm). Various observations viz. time of grinding, energy consumption, LN₂ consumption, and essential oil content of ground powder were taken. The combination of -60°C feed temperature, 8 kg/h feed rate and 0.8 mm sieve size was found to be best treatment for production of superior quality ajwain seed powder. The optimized cryoground ajwain seed powder was taken for SFE study, The parameter like temperature (35,40,45,50,55°C), pressure (100,150,200,250,300 bar), dynamic time (30,60,90,120,150 min) and static time (30,45,60,75,90 min) were evaluated with respect to essential oil yield and thymol content. The optimization of Supercritical fluid extraction was carried out by using central composite design. The optimized condition of temperature 35°C, pressure 300 bar, dynamic time 65 min and static time 30 min, yields essential oil of 3.9% and thymol content of 60%.



Khushbu Vahora
(2017-2019)

EFFECT OF NANO-EMULSION COATING ON SHELF LIFE OF TOMATO FRUITS



Dr. R. F. Sutar

Abstract

Tomatoes being a climacteric fruit is one of the most widely consumed and the second most important vegetable crop worldwide. Tomato fruit is rich source of antioxidants such as carotenoids (especially, lycopene and β -carotene). The shelf life of tomatoes under ambient conditions is very short due to highly perishable nature. Tomatoes are subjected to wide range of post-harvest treatments. Edible coating is one such treatment used to reduce the post-harvest losses. Today, nanotechnology represents an area of opportunity for developing vehicles to transport certain active compounds such as antimicrobials. Applications of this emerging technology to the development of edible coatings includes nano-emulsions. The research work entitled “Effect of Nano-emulsion Coating on Shelf life of Tomato Fruits” comprising two sets of experiments were conducted with a broad aim of increasing shelf life of tomato fruits at ambient temperature. In first of experiments characterization and stability study of nano-emulsion was conducted for selection of the combination of ingredients of nano-emulsion. The second sets of experiments were carried out to study shelf life of tomatoes, using the coating of selected nano-emulsion. Nano-emulsion was prepared using gum arabic as the base material. Different combinations of nano-emulsion were prepared using three different levels of gum arabic (0.5, 1.0, 1.5%), glycerol (0.5, 0.75, 1.0%) and sodium benzoate (1.0, 1.5, 2.0%). And in all the combinations 0.75% oleic acid and 0.2% Tween20, as an emulsifier were added. All the combinations of nano-emulsion were analysed for size (nm), poly dispersivity index (PDI), kilo count per second (kcps) and Zeta potential at the interval of 10 days for 1 month. From the characterization and stability study nano-emulsion combination GA:Gly:SB – 1.0:0.5:1.5% was selected for the coating on tomato fruits, as it was having lowest size of 41.75 nm, with good count rate and PDI. In addition to that it also had high zeta potential of -34.4 mV, maintaining sufficient electrostatic repulsion between dispersed nanoparticles and dispersion medium thus having physical stability. Freshly harvested breaker stage tomato fruits (cv.GAT-5) were coated by selected nano-emulsion using five different dipping time periods i.e. 1, 2, 3, 4, 5 min. Coated tomato fruits were stored at room temperature. During the storage period different physical (physiological loss in weight, per cent spoilage, color, firmness and respiration rate), chemical (total soluble solids, pH, titratable acidity and lycopene content) parameters were analysed at an interval of 3 days. Based on spoilage (%), the maximum shelf life of 24 days was found in fruits coated with nano-emulsion by dipping for 4 mins. This was followed by fruits coated with nano-emulsion by 5 min dipping (21 days). The minimum shelf life of 9 days was observed in the control.



Harsh Raval
(2017-2019)

UTILIZATION OF MORINGA LEAVES POWDER INTO SELECTED FOOD PRODUCTS



Dr. S. H. Akbari

Abstract

India and other parts of the world, drumstick i.e. *Moringa* leaves have been used as a nutritional supplement and now it is beginning to gain popularity in the entire society due to its medicinal and food value. *Moringa* leaves contain all of the essential amino acids in a good proportion, which are the building block of proteins. *Moringa* leaves are rich source of major and trace elements viz. calcium 440 mg, phosphorous 70 mg and iron 0.85 mg/100g of fresh leaves. Commercialization of various value added *Moringa* products is the only way to utilize this commodity. Looking to the health prospect of the *Moringa* leaves and its market demand, there is a great scope for the value addition of *Moringa* leaves in terms of development of value added food products. *Moringa* leaves were dried using vacuum dryer keeping 45°C temperature and 450 mmHg pressure for 150 min to achieve 5% (w.b.) final moisture content. The SCF extraction was carried out keeping 45°C temperature, 30 MPa pressure, 45 min static time and 180 min dynamic time to get maximum yield of extract and β -carotene. *Moringa* leaves extract at different levels i.e. 100, 250, 500, 750 and 1000 μ g/100g as well as de-extracted *Moringa* leaves powder with different levels 1, 2, 3, 4 and 5 g/100g were incorporated into food products i.e. cookie and khakhra. 1000 μ g *Moringa* leaves extract incorporated in cookies and 750 μ g in khakhra gave highest sensory attribute while cookies and khakhra incorporated with de-extracted *Moringa* leaves powder @ 3 g and 2 g, respectively found better. All the standardized food products packed into different packaging materials i.e. cookies into PET boxes and khakhra were vacuum packed into metalized pouches and subjected for storage of 60 days. The product quality of all the standardized food products was analyzed for vitamin C and β -carotene content and found better sensory till storage study.



Snigdha Bhardwa
(2017-2019)

DEVELOPMENT OF THE MULTI FRUIT SMOOTHIE



Dr. Samit Datta

Abstract

The present research study entitled “Development of the Multi Fruit Smoothie” was conducted with an idea to produce thermally processed and packaged multi fruit smoothie with longer shelf life. Smoothie is a creamy cold drink, which is conventionally made of blended fruit or berries together with fruit juice and optionally with yoghurt, other dairy products or other ingredients. The objectives of the study were to optimize the formulation for the multi fruit smoothie, to standardize the thermal treatment given to the product for the extension of shelf life, to characterize the final product for physicochemical, nutritional, microbiological and sensory quality of the final product and to evaluate the shelf life of the product in three different packaging materials. The study was the part of the effort to provide nutritional 'on-the-go' fruit based drink, containing custard apple, an under-utilized perishable fruit. D-Optimal model of Mixture Design at different range was adopted for three variables viz. custard apple pulp, mango pulp and pineapple juice, to optimize the formulation for multi fruit smoothie. Optimized product was prepared by mixing 28.92% of custard apple pulp, 30.90% of mango pulp, 39.88% of pineapple juice and 0.30% of xanthan gum with high color and appearance (8.35), taste (8.75), aroma (8.46), consistency (8.41) and overall acceptability (8.86) score. Temperature-time combination of 85°C/15 min was selected as it rendered the highest desirability of 0.927. The final product contained moisture, protein, fat, crude fibre, ash and carbohydrate content of 74.52, 0.69, 0.31, 0.64, 0.57 and 23.60%, respectively. The other physico-chemical parameters obtained for the same were 25.26 °Brix TSS, 3.78 pH, 0.510% titrable acidity, 12.77% reducing sugar, 20.46% total sugar, 0.0909 nonenzymatic browning, 3749.57 cp viscosity and 0.89 color value (ΔE_{ab}). Nutritional information for one serving (200 ml) of multi fruit smoothie was calculated as 254.86 Kcal of energy, 0.791 g of fat, 1.759 g of protein, 60.18 g of carbohydrates, 1925.60 IU of vitamin A, 97.43 mg of vitamin C and 5.50 mg of iron. Microbiological quality of the product was enumerated in terms of total plate count, yeast and mold count and coliform count which were observed as 1.01 log cfu/ml, 1.14 log cfu/ml and not detectable, respectively. The sensory quality of the product was determined by analysing the attributes like colour and appearance (8.78), taste (8.54), aroma (8.73), consistency (8.69) and overall acceptability (8.48). Under refrigerated condition, smoothie packed in metallized polyester spout pouch had shown the maximum shelf life of 84 days in comparison to 70 days for the product in glass bottle and 42 days for product packed in polypropylene bottle. Similarly, smoothie packed in metallized polyester spout pouch had maximum shelf life of 49 days in comparison to 35 days for glass bottle and 21 days for polypropylene bottle under ambient temperature storage.



Hiral Patel
(2017-2019)

PRODUCTION TECHNOLOGY OF DEHYDRATED BOTTLE GOURD SHREDS



Dr. R. R. Gajera

Abstract

Bottle gourd (*Lagenaria siceraria*) is an important vegetable which play a significant role in human diet and it is belonging to the Cucurbitaceae family. It is difficult to consume fresh bottle gourd to meet daily recommended requirement because of tedious task of processing. For convenience in adoption of bottle gourd for daily use or in diet, it is more convenient to be converted into dried/dehydrated shreds or powder form; so as to make it available as and when required. Preparation of bottle gourd shreds or powder is one of the viable technologies for utilization of bottle gourd fruits. Experiments were carried out for standardizing the processing and storage parameters for production of dehydrated bottle gourd shreds. Different sized shreds (3, 5 and 7 mm thickness) were prepared by shredding machine. Steam blanching was carried out to inactivate POD enzyme and the process was optimized based on minimum POD inactivation time, maximum ascorbic acid content, maximum TSS and minimum juice yield. The optimized steam blanching treatment was 6 min POD inactivation in 3 mm size shreds. The ascorbic acid content, TSS and juice yield was 7.084 mg/100g, 2.83 °Brix and 62.93%, respectively. Optimized shreds were utilized for further dehydration process. The shreds were pre-dried in microwave continuous dryer (MCD) at constant conveyor speed (0.3 cm/s) and final dehydration was carried out by fluidized bed dryer (FBD) at different drying temperature (55, 60 and 65°C) and air velocity (6, 8 and 10 m/s). Optimization of dehydration parameters were accomplished on the basis of dehydration time, ascorbic acid content, color value (ΔE^*ab) and rehydration characteristics of bottle gourd shreds. The best results were found at 65°C drying temperature and 10 m/s air velocity of fluidized bed dryer, as the ascorbic acid content was found 5.68 mg/100g, rehydration ratio was 12.93%, color value (ΔE^*ab) was 1.33 and minimum dehydration time was 58.56 min. Pre-treated optimized dehydrated bottle gourd shreds were filled in polypropylene pouch and metalized laminated pouch to conduct storage study for 120 days at ambient condition. Stored samples were analysed for its sensory characteristics, physico-chemical characteristics and microbial characteristics at the interval of 15 days. Sensory score for optimized sample was more than the control samples. In ascorbic acid no significant difference was found for all samples but it decreases faster in control sample packed in polypropylene pouch and metalized laminated pouch during storage study. For color values (ΔE^*ab) significant difference was found during storage period. Dehydrated sample packed in polypropylene pouch and metalized laminated pouch were microbiologically safe over the control samples. Calcium and potassium content were found more in optimized sample over the control samples. Dehydrated sample packed in metalized laminated pouch was found better than the other sample during shelf life study.



Rohan Parmar
(2017-2019)

DEVELOPMENT OF MAHUA (MADHUCA LONGIFOLIA) FLOWER ENRICHED NUTRI-CEREALS BASED LADDOO FOR LACTATING WOMEN



Dr. Samit Datta

Abstract

The present research study entitled “Development of mahua (*Madhuca longifolia*) flower enriched nutri-cereals based Laddoo for lactating women” was conducted with an idea to prepare and to assess the shelf life of vacuum packed Laddoo stored under different conditions. The objectives of the study were to evaluate nutritional profile of raw ingredients; to standardize formulation of mahua flower enriched nutri-cereal based Laddoo, to characterize the final food product for nutritional and quality parameters and to evaluate the shelf life of the product in vacuum packaging material. To cater the elevated demand of nutrition during lactating period, mahua flower, wheat and finger millet were selected as major ingredients. Mahua flowers were found to be rich in carbohydrates, protein, fat, calcium, iron and phosphorus whereas the cereals/millet contain certain important minerals. Composite rotatable experimental design (CRD) was adopted to standardize the formulation of mahua flower enriched nutri-cereal based Laddoo. On 9-point hedonic scale the maximum score of color, taste, aroma, body and texture and overall acceptability were found to be 7.99, 7.99, 7.88, 7.77 and 7.77, respectively. There was significant effect of interactions among ingredients on organoleptic parameters. Profiling of the final product showed moisture, protein, fat, crude fibre, ash and carbohydrate that were 10.36, 13.74, 12.09, 3.09, 2.08 and 46.36%, respectively. Whereas vitamin C, calcium, iron and phosphorus content of Laddoo were 1.33, 132.56, 4.05 and 188.05 mg/100g, respectively. The hardness of Laddoo was measured as 175.22 N. Microbiological quality of the product was enumerated with the help of the total plate count and yeast and mold count which were observed as 4.43 and 1.17 log cfu/g, respectively while coliform count in the product was found to be absent. The standardized product was packed in PVC tray and metalized pouch as primary and secondary packaging materials, vacuum was applied, and then stored at 30±2°C and refrigeration temperature (7±2°C) and were assessed for their moisture, hardness, FFA and sensory attributes such as color and appearance, body and texture, taste and overall acceptability during storage. On storage at 30±2°C temperature and refrigeration temperature (7±2°C), it was observed that the moisture content of Laddoo decreased while FFA content was increased. Hardness was found to be decreased at 30±2°C temperature while it was found to be increased at refrigeration temperature (7±2°C). In addition to this, sensory attributes scores were also found to be decreased, mainly due to development of rancidity in 30±2°C temperature.



Hrtvika Ghadiyali
(2017-2019)

EXTRACTION AND ENCAPSULATION OF POLYPHENOLS FROM MANGO SEED KERNEL



Dr. R. V. Prasad

Abstract

The present study was aimed to extract and encapsulate polyphenols from mango seed kernel. Alphonso and kesar varieties were used in present study. Microwave assisted extraction (MAE) is a new method in which microwave energy is used to heat polar solvents in contact with solid thereby reducing both extraction time and solvent consumption. Traditional reflux method and (MAE) are studied for extraction of polyphenols. The proximate and biochemical analytical values of moisture, fat, protein, fiber, ash carbohydrate, total polyphenols and antioxidant activity observed were 37.37%, 9.66%, 12.76%, 2.33%, 3.09%, 54.53%, 167.82 mgGAE/g and 0.56 ppm for alphonso variety and 42.4%, 9.33%, 11.09%, 2.06%, 2.4%, 51.54%, 193 mgGAE/g and 0.38 ppm for kesar variety, respectively. MAE method was compared with reflux method. To optimize extraction methods, mango varieties, solvents (methanol and acetone) and extraction methods were evaluated with sample/solvent ratios (1:10, 1:20, 1:30, 1:40 and 1:50), yield (%), total phenolics and antioxidant activity (IC_{50}). For extraction of phenols in kesar variety, MAE was selected with methanol as a solvent at 1:20 sample/solvent ratio. Yield, total phenolics and antioxidant activity (IC_{50}) of optimized extract were 22.67%, 62.85 mgGAE/g and 2.255 ppm respectively. Encapsulation of optimized extract was performed by spray drying. Optimized extract was screened with different binding materials gum Arabic, maltodextrine, inulin, soy protein isolate and whey protein isolate. Whey protein isolate was selected as binding material on the basis of total phenolics and encapsulation efficiency. Outlet temperature (80 and 90°C) and core to binder ratio (1:4, 1:5 and 1:6) were optimized and moisture, total phenolics and encapsulation efficiency were evaluated. The optimized conditions observed for encapsulation of polyphenols with WPI as binding material were core/binder ratio of 1:5 and 90°C outlet temperature. The encapsulated powder had 3.14% moisture, 27.47 mgGAE/g total phenolics, 80.11% encapsulation efficiency, 0.0937 g/cm³ density and 22.40 μm average diameter.



Mahesh Khatri
(2017-2019)

STANDARDIZATION OF TECHNOLOGY FOR PRODUCTION OF WHOLE DRIED LIME



Dr. S. H. Akbari

Abstract

Lime fruits are important in day to day life for their distinct flavor, color, aroma and usages in different purpose. Lime is rich in vitamin C and flavonoid that have a powerful antioxidant property. Vitamin C is essential for a strong immune system and hence prevents the illness such as flu, colds and recurrent ear infections. Lime and its derivatives including lime juice, lime peel and lime oil provides a whole range of medicinal properties. Fresh lime can be stored at an ambient condition for 3-5 days and in Controlled Atmospheric (CA) storage up to 3 months depending upon the variety and quality of fruits. Enhancement of the shelf-life of lime may also prove beneficial for its utilization during the off-season also. The dehydration of lime is one of the major lime processing operations which reduce the volume and thereby transportation cost and increases the storage life of lime. Dehydration of lime helps to improve keeping quality and alleviate irregularity in price fluctuation during off season. The physical properties of lime viz., weight, size, sphericity and peel to juice ratio were determined at 86.68% (w.b.) moisture content for freshly harvested yellow variety of Kagzi lime. The average values of size and sphericity of whole limes were found to be 43.70 mm and 0.92, respectively. The weight and peel to juice ratio of whole limes were found to be 40.53 g and 0.30, respectively. The ascorbic acid content and titratable acidity of fresh whole limes were found to be 31.41 mg/100g and 6.36% (CA), respectively. Different drying techniques and pre-treatments were used to suggest the standardized drying conditions to get good quality dried whole limes. The effect of drying technique, drying temperature and pre-treatments on the drying time, ascorbic acid content, titratable acidity and sensory attributes were studied. It could be recommended that the drying of whole lime (Kagzi variety) should be carried out at 55°C drying temperature without any pre-treatment to fresh whole lime gave satisfactory quality of dried whole limes with 183 hours of drying time. The final product (whole dried lime) found to have 134.83 (mg/100g) ascorbic acid content and 25.99% (CA) titratable acidity. The whole dried limes packed in different packaging materials and their effect on the product quality was analyzed as storage-life at ambient conditions.



Kripali Dave
(2017-2019)

PERFORMANCE EVALUATION OF SOLAR HYBRID REFRIGERATION SYSTEM FOR STORAGE OF FRUITS AND VEGETABLES USING ARTIFICIAL NEURAL NETWORK (ANN)



Dr. S. S. Kapdi

Abstract

India is the second largest country producing variety of fruits and vegetables but the deterioration of the quality of fruits and vegetables takes place immediately after harvest due to lack of farm storage structures. Storage of fruits and vegetables after storage is the most pressing problems in the tropical countries like India. Hence, refrigeration is used to store the perishables at low safe storage conditions. Commonly two types of refrigeration systems are used namely: vapour compression refrigeration system and vapour absorption refrigeration system. In the case of vapour compression refrigeration systems mechanical energy is used to drive the system but the vapour absorption refrigeration systems use heat energy instead of mechanical energy. Thus this system can be used where the electric power is not available. But these refrigeration processes demands higher requirement of electricity which is the most critical problem in rural areas now a days. Hence, the problem of power generation can be addressed by switching to renewable rather than by using the conventional electricity. To improve the system performance, some studies have investigated the characteristics of the system by using a simulation method where the modeling of solar absorption refrigeration system can be developed by using physical-based model through fundamental laws of energy-mass balance, heat transfer, and flow balance. For the present study, simple curve fitting method is used in mathematical modelling. But it is important to develop a suitable model for better understanding of the controlling parameters of the complex process of solar hybrid refrigeration system. Artificial Neural Network (ANN) is one such tool which can help in predicting the performance of the complex refrigeration systems. The solar radiation intensity was found in the range of 9.15 W/m^2 to 902.42 W/m^2 when measured throughout the day (6:00 h to 19:00 h) in the months of January, February, March and April. Also, the hot water inlet temperature was found in the range of $75\text{-}90^\circ\text{C}$. The efficiency of solar thermal system was found to be 42.25%. Similarly, the heat flow rate for cooling in chilled water system and cooling tower were found to be 63,0000 kJ/h and 1,61,000 kJ/h, respectively. In mathematical modeling, simple curve fitting method was used. For system parameters, the value of regression coefficient in mathematical modeling was found in the range of 0.8316 – 0.9643. Similarly, in case of product parameters the regression coefficient in mathematical modeling was found in the range of 0.8138–0.9790. Again, in ANN modeling, the regression coefficient for system parameters ranged between 0.97207–0.99812. Again for product parameters, the regression coefficient obtained in ANN modeling was in the range of 0.97802–0.99585. The comparison of both the modeling technique showed that the ANN modeling showed more efficient values than that of the mathematical modelling. Hence, for the present system, the ANN model can be successfully used.



Kandarp Sadhu
(2018-2020)

STANDARDIZATION OF TECHNOLOGY FOR PRODUCTION OF PREMIUM QUALITY FENNEL SEED POWDER USING CRYOGENIC GRINDING



Dr. R. F. Sutar

Abstract

Fennel (*Foeniculum vulgare*) is a biennial or perennial herbaceous plant, belonging to the Apiaceae family. Fennel seeds are very popular as effective household treatment for common ailments, particularly stomach inflammation. Fennel seed and oil are used to promote health, in prevention of diseases, and as a flavouring agent in food items. The essential oils and various extracts from fennel have been shown to possess antimicrobial, anticarcinogenic, antioxidant, antihirsutism, memory-enhancing property, antiaging effects, antimutagenic effect and antistress activities. Cryogenic grinding is method of powdering products at sub-zero temperature ranges from 0 to -195°C. The present investigation was undertaken to optimize cryogenic grinding parameters to obtain superior quality of fennel seed powder. Fennel seed contain moisture content $6.70 \pm 0.25\%$, carbohydrate content by difference $44.32 \pm 0.38\%$, protein content $7.52 \pm 0.77\%$, total fat $13.65 \pm 0.46\%$, crude fiber content $18.42 \pm 0.34\%$ and volatile oil $2.4 \pm 0.037\%$. The effect of grinding temperature (ambient, 0, -20, -40, -60, -80, -100°C), feed rate (12, 14 and 16 kg/hour) and sieve size (0.8, 1.0 and 1.5 mm) were evaluated with respect to grinding time, volatile oil content, anethole content, fenchone content, estragole content, energy consumption and liquid nitrogen consumption. The optimization of cryogenic grinding of fennel was carried out using 3 factor completely randomized design. For fennel when grinding temperature was decreased from ambient to -100°C the amount of volatile content increased from 0.72 to 1.67%. Optimized condition for cryogenic grinding of fennel seed powder was -100°C temperature, 1.5mm sieve size, 16kg/hour feed rate. Volatile oil extracted at optimized cryogenic grinding condition had volatile oil yield of 2.0% containing anethole 1258.30 mg/100g, fenchone 147.30 mg/100g and estragole 73.94 mg/100g. This resulted in retention of 83.33% of volatile oil in cryogenically grounded powder compared to 49.16% obtained from ambient grinding. All cryo-ground fennel seed powder samples were stored in aluminium laminated zip lock bags at ambient conditions ($34 \pm 2^\circ\text{C}$). All the samples' storage study was carried out for 100 days at the interval of 50 days. Fennel seed powder (ambient condition), the anethole, fenchone and estragole content decreased from 831.59 to 459.29, 68.73 to 52.91 and 55.70 to 30.61 mg/100g respectively, at the interval of 0 to 100 days. However, in the case of cryo-ground fennel seed powder (-100°C) anethole, fenchone and estragole content decreased from 1258.30 to 531.06, 147.30 to 89.53 and 73.94 to 31.91 mg/100g respectively.



Mehul Chudasama
(2018-2020)

TECHNOLOGY FOR PRODUCTION OF TOMATO KETCHUP SLICE



Dr. S. H. Akbari

Abstract

Tomato ketchup is one of the most popular food stuffs consumed worldwide and contain higher amount of lycopene compared to raw tomato. New food product and innovation is necessary for the susceptibility of the product in the market. Tomato ketchup slice can be convenient to both manufacturers and consumers for easy handling, transportation and storage. Tomato ketchup slice has lower moisture content and is more concentrated which significantly increase lycopene content compared to normal tomato ketchup. Commercially tomato ketchup is prepared from tomato paste or puree, cooked with other ingredients like sugar, salt, acetic acid, spice oleoresins, modified starch and hydrocolloids. Tomato paste having 70 % moisture content and 28 % Brix TSS was used for preparation of tomato ketchup. Tomato ketchup was processed at 80 °C until TSS of 38 ± 2 % Brix achieved. Modified starch @ 1.00 % was found to give optimum consistency. Different hydrocolloids viz. pectin, acacia gum, xanthan gum and guar gum with their different levels (1.00, 1.50, 2.00 and 2.50 %) were replaced in the tomato ketchup recipe to standardize hydrocolloid and its level to get stable texture and structure of tomato ketchup slice. TKS was prepared using different drying temperature i.e. 60, 70 and 80 °C to get most suitable drying temperature. Pectin @ 0.75 % and drying temperature of 60 °C were found to give stable texture and other sensory attributes to TKS. Standardized tomato ketchup slices were sandwiched between two parchment papers and packed in aluminium laminated LDPE pouches and stored for 60 days at ambient conditions. Standardized tomato ketchup slice was found to have lycopene content of 22.42 mg/100g compared to tomato ketchup i.e. 15.45 mg/100g. Lycopene content of TKS was negligible reduced to 21.81 mg/100g even after 60 days of storage period. Standardized tomato ketchup slice was found safe to consume even after 60 days as water activity was found to be < 0.6 and no microbial growth was observed during storage period.



Shila Sarvade
(2018-2021)

**PRODUCTION TECHNOLOGY OF NECTAR FROM AONLA
FRUIT (INDIAN GOOSEBERRY) USING STEVIA AS
NATURAL SWEETENER**



Dr. R. R. Gajera

Abstract

Experiments were carried out for standardizing the processing and storage parameters for production of aonla nectar. Hot water blanching of aonla fruits at different time (3, 6, 9 and 12 Min) and temperature (85, 90 and 95 °C) was evaluated for the quality and its juice yield and the process was optimized on the basis of the maximum retention of nutrients and the minimum loss in yield of juice. The most effective water blanching treatment was found at 3 min at 95°C. The juice yield, ascorbic acid contents, pH and TSS of aonla juice were found to be 52.10%, 452 mg/100g, 2.60 and 12.02 °Brix, respectively. Completely randomized design (CRD) was used to formulate and analyzed the aonla nectar. Different variables tested were aonla juice as 20 % (fix parameter), sugar and stevia in the range of 10-20 % and 0.25-1%, respectively in response to value of pH, TSS °Brix, acidity, ascorbic acid content and OAA of aonla nectar. The optimized product the pH, TSS °Brix, acidity, ascorbic acid content and OAA was found to be 3.26, 18.60 °Brix, 0.33%, 73.65 mg/100 ml and 7.33, respectively at aonla juice 20%, sugar 15% and stevia 1%. Optimized aonla nectar was hot filled in 200 ml pre-sterilized PET bottles then pasteurized at 90°C for 1 min. Optimized aonla nectar was evaluated for its quality characteristics during ambient (30 ± 2 °C) and refrigerated (7 ± 2 °C) storage for 45 days. Sensory score of the aonla nectar was decreased during storage. Ascorbic acid decreased during storage while acidity, reducing and total sugars were increased. The total plate count of the aonla nectar was 6 cfu/ml and was increased to 18 cfu /ml. The yeasts and molds count of the optimized aonla nectar was 2 cfu /ml and was increased to 4 cfu /ml at 45 days during ambient storage. The cost of aonla nectar was analyzed considering operation days of the product i.e. 120 days according to seasonal availability. Project is viable only, if one can process another products throughout the year.



Sweta Gohel
(2017-2019)

SHELF-LIFE EXTENSION OF DATE PALM FRUIT USING NANOCOATING



Dr. R. F. Sutar

Abstract

Date palm fruits (*Phoenixdactylifera* L.) are delicious and medicinally important fruits, cultivated throughout the tropical climate countries. Due to highly perishable in nature and fast ripening process, it has short post-harvest life. To enhance the shelf life of date palm fruit post-harvest interventions are necessary. The results of the experiments showed that among coating, Chitosan nanoparticle dipping for 4 min coated date palm fruits and stored at $37\pm 3^{\circ}\text{C}$, revealed lower physiological loss in weight (21.33%), spoilage (35%), total soluble solids (45.29°B), firmness (244.80 N), pH (6.23), titratable acidity (0.33%), reducing sugar (54.90 g/100g), and higher sensory score more than 7, thereby increased shelf life (6 days) of date palm and proved to be the best. It was observed that the physiological loss in weight and spoilage trough out the storage period were significant less compared to the other edible coating formulations. Among the Chitosan nanoparticle dipping for 4 min coated date palm fruits stored at 25°C recorded lower physiological loss in weight (17.16%), spoilage (22.22%), total soluble solids (27.15 °B), firmness (219.48 N), pH (6.45), titratable acidity (0.33%), reducing sugar (52.86 g/100g), and higher sensory score more than 7 and thereby recorded higher shelf life (6 days). The Barhee variety date palm fruit treated with Chitosan nanoparticle dipping for 2 min coated fruits stored at $37\pm 3^{\circ}\text{C}$ enhanced the shelf life up to 3 more days. Treated sample was lower physiological loss in weight (29.20%), spoilage (26.67%), total soluble solids (22.78 °B), firmness (195.76 N), pH (5.86), titratable acidity (0.33%), reducing sugar (36.44 g/100g), and higher sensory score. Edible coating with nanoparticle effect significantly to date palm fruit and facilitating shelf life to date palm fruit; there by benefitting the growers and consumers.



Ashruti Maradiya
(2017-2019)

AQUEOUS OIL EXTRACTION FROM GROUNDNUT USING LOW FREQUENCY OHMIC HEATING



Dr. A. Nema

Abstract

Groundnut or peanut (*Arachis hypogaea* L.) is a major source of edible oil containing fat, proteins and vitamins. Nuts are an important component of a balanced diet due to their high nutritional value. Groundnut seeds contain high content of digestible proteins (22-30%), vitamins (E, K & B group), minerals (phosphorus, calcium, magnesium and potassium) and phytosterols. The ohmic heating treatment, a new technological process was undertaken for studying the effect of low frequency ohmic heating on enhancement of oil recovery and quality of oil. The experimental process includes cleaning, low frequency ohmic heating, incubation and aqueous extraction of oil and quality evaluation methods of groundnut seeds. The effect of low frequency ohmic heating parameters namely frequency (Hz), temperature (°C) and holding time (min.) on oil extraction process were investigated. Three levels of frequency (10, 15 and 20 Hz), temperature (70, 80 and 90°C) and holding time (2, 4 and 6 min) were taken as independent variables using full factorial design. The optimization of ohmic heating parameters was carried out using numerical optimization technique. The electrical conductivity and specific heat of groundnut slurry were in the range of 0.07 to 0.51 mS/cm and 0.43 to 10.69 kJ/kg°C, respectively. Percentage oil recovered from groundnut slurry through aqueous extracted oil by application of ohmic heating varies from 7.61 to 84.77%. The maximum oil recovery 84.77% was obtained when the sample was heated and maintained at 20 Hz frequency, 90°C final temperature and 6 min. of holding time as against 66% in control sample. The free fatty acid (FFA) of the extracted oil (1.8 to 2.7%) was within the acceptable limit of 3% (oleic acid) and 0.5-3% prescribed respectively by PFA and BIS. The peroxide value of extracted oil was also found within the acceptable limit (4.20 to 7.39 meq/kg). The effect of all studied parameters on oil quality parameters were significant and optimum heating conditions at 15 Hz frequency, 80°C final temperature and 6 min. of holding time.



Deval Rathod
(2017-2020)

STUDY ON MICROWAVE ASSISTED DEHYDRATION OF AONLA SEGMENTS, SHREDS AND MANGO SLICES



Dr. A. K. Sharma

Abstract

The drying characteristics and quality of the aonla segments, shreds and mango slices processed with osmotic and microwave drying were investigated. Osmotic (sugar concentration 40, 50, 60 and 70°brix, fruit to sucrose solution ratio 1:4 w/w) dehydration for ~50% (of initial available) loss in moisture at a) atmospheric pressure and different solution temperatures (40, 50, 60 and 70°C) for ~6h and at b) atmospheric pressure and microwave environment (belt speed 2, 4, 6 rpm and active magnetron 2, 3, 4) was carried out. The best conditions found for osmotic dehydration process were 1) for segments: 40°Brix sugar syrup concentration, 2 RPM belt speed with 4 active magnetrons, 2) for shreds: 40°Brix sugar syrup concentration, 4 RPM belt speed with 3 active magnetrons and 3) for mango slices: 50°Brix sugar syrup concentration, 4 RPM belt speed with 2 active magnetrons. Microwave conveyor dryer for second stage drying yielded product with highest overall acceptability score. Dried products were stable and microbiologically safe during the storage period of 3 months.



Arunima Mukherjee
(2018-2020)

STANDARDIZATION OF DRYING TECHNIQUE FOR THE PRODUCTION OF POWDER FROM SHANKHPUSHPI LEAVES



Dr. A. Nema

Abstract

Shankhpushpi (*Convulvulus microphyllus*) is a nootropic, perennial wild herb which is widely used in Ayurveda (Indian traditional medicine system). In Ayurvedic texts, Shankhpushpi is mentioned as one of the Medhya Rasayana. Medhya Rasayanas as described in Ayurveda are a group of medicinal plants with benefits, specifically to improve memory and intellect. One of the earliest post-harvest operations and the most common way to preserve the quality of medicinal plants is drying. Generally, the traditional drying methods such as shade drying and open sun drying are practiced for medicinal herbs. These traditional methods of drying have several drawbacks pertaining to the drying of medicinal herbs. To overcome the above mentioned drawbacks of traditional drying, mechanical dryers may be used for the drying of the medicinal herbs. Physical properties of cleaned and sorted fresh Shankhpushpi leaves such as length, breadth, width and colour, were analysed. Proximate analysis such as moisture content (70.5%), ash content (3.92%), fat content (0.40%) and crude fiber content (10.68%) of fresh leaves was performed. Total phenol content (19.23 mg GAE/g) and water activity was also studied. The drying experiments were conducted with three different techniques i.e. hot air drying (40, 45, 50°C), greenhouse drying and sun drying (control). The dried samples were subjected to grinding operation in a pulverizer and further sieved to produce powder with uniform particle size. The powder was packed in aluminium coated HDPE pouches for further analysis. The powder that was obtained from different drying techniques was subjected to further physico-chemical analysis for comparative study. The effective diffusion coefficient for hot air drying at 40, 45 and 50°C were calculated to be 5.548×10^{-12} , 1.124×10^{-11} and 5.85×10^{-11} m²/s, respectively. The effective diffusion coefficient for green house drying and open sun drying were also evaluated to be 5.85×10^{-12} and 1.1096×10^{-11} m² /s, respectively. The drying data was fitted in six different thin layer models. Among them Page (with modification) model was found to be most suited for maximum of the drying techniques with highest R² values and corresponding lowest RMSE and SSE values. It was found that hot air drying at 40°C was most suitable whereas, open sun drying was least suitable method of drying in terms of colour and phenol retention and powder flowability.



Shalini Singh
(2018-2021)

**STUDY ON DRYING CHARACTERISTICS OF CUSTARD
APPLE PULP USING DIFFERENT DRYERS**



Dr. A. K. Sharma

Abstract

Drying of custard apple pulp was carried out using tray (hot air) dryer, vacuum dryer, tray dryer followed by microwave assisted dryer, and freeze dryers. Maltodextrin (15, 20 and 25 %) as drying aid and 1% tricalcium phosphate as anticaking agent were used. The pulp was dried at different temperatures (45, 50 and 55°C). Mathematical models were fitted to the experimental drying data of thin layer (~2 mm) custard apple pulp. Origin software was used for the purpose. The suitable model for each dryer was reported. Further, dried samples were analysed for solubility index and recovery.



Jigisha Pargi
(2017-2019)

STUDY OF GAMMA IRRADIATION TREATMENT FOR DEGRADATION OF PESTICIDE RESIDUES IN SELECTED LEAFY VEGETABLES



Dr. H. G. Bhatt

Abstract

The green leafy vegetables, cabbage, kale, amaranth, spinach, fenugreek, coriander etc. are most common vegetables cultivated throughout the country. Pesticides like Profenophos, Chlorpyrifos, Triazophos and Quinalphos have been found effective for the management of these vegetable crops. These pesticides are Organophosphate group and used on wide variety of vegetable crop to control many pests. Farmer are using large amount of pesticide during the entire period of cultivation for better production. Most of the farmers don't follow the guideline for recommended doses and waiting period between the last spray and harvest. Due to this vegetable contains pesticide residues and it will adversely affect the human health. Therefore, the present study was undertaken entitled as “Study of gamma irradiation treatment for degradation of pesticide residues in selected leafy vegetables” with the aim of degradation of pesticides. In order to generate field level spiking of the insecticides under study on leafy vegetable, control plots of these vegetables were sprayed with the mixture of the pesticides at double the recommended dose at Main Vegetable Research Station, Anand Agricultural University, Anand. The vegetables were harvested after 24 hours of application of pesticides. The vegetables were immediately subjected to residues analysis to know the initial levels and also were subjected to gamma irradiation and also for the microbial and physical analysis. Optimization of dose of gamma irradiation were accomplished on the basis of maximum degradation of pesticide residues and microbial decontamination of green leafy vegetables. The results revealed that 10 kGy gamma irradiation treatment was found the most effective treatment for reduction of all four pesticides in spinach leaves (46.04%), fenugreek leaves (47.09%) and coriander leaves (51.08%). Maximum reduction in TPC was found 2.69 and 3.07 cfu/g in spinach and fenugreek leaves respectively while in case of coriander leaves 2.38 log cfu/g reduction was observed at 7.5 kGy but it was below the detection limit detected at 10 kGy gamma irradiation treatment. During shelf life study, it was observed that the effect of irradiation treatment on PLW and spoilage was found to be significantly lower as compared to control and thereby shelf life was extended up to 2,4 and 2 days for spinach, fenugreek and coriander leaves, respectively. However, total plate count was less in gamma irradiated sample as compared to control (non-irradiated). During the entire storage period, no yeast and mold & coliform was found in all the gamma irradiated treated green leafy vegetables.



Akhtarhusain Saiyad
(2017-2019)

EFFECT OF ATMOSPHERIC PRESSURE COLD PLASMA (APCP) AND UV-C TREATMENT ON SELECTED PESTICIDES AND MICROORGANISMS IN CUMIN SEEDS



Dr. R. V. Prasad

Abstract

Atmospheric pressure cold plasma (APCP) and UV-C is a novel emerging non-thermal technology that has attracted attention as a decontamination tool in food and healthcare sectors. This study investigated the antimicrobial efficacy of APCP and UV-C against microbiological risks and pesticide residues associated with fresh foods. A range of critical control process parameters were investigated with respect to key pathogenic and spoilage microorganisms and pesticide residues commonly implicated in the food environment. The inactivation efficacy of APCP as well as UV-C against all selected bacterial strains and selected pesticides was depended on voltage, distance and treatment time. Maximum decontamination of microorganisms and degradation of pesticide residues was observed for APCP at 5 kV for 24 min of exposure time and for UV-C at 3 cm distance for 60 min of exposure time. When the selected microorganisms *E. coli*, *S. typhi*, *E. aerogenes* and *S. aureus* were spiked on cumin seeds and treated with APCP showed 3.28, 3.30, 2.28 and 2.37 log reductions at 5 kV for 24 min, respectively. When pure culture of microorganisms were treated with APCP, 3.20, 2.25, 3.12 and 2.15 log reductions were observed at the same respective voltage and treatment time. Degradation of quinalphose, profenofos, chlorpyrifos and ethion residues in cumin seeds by APCP treatment was in the range of 0.17-7.25, 2.79-15.99, 3.78-28.72 and 6.26-23.68%, respectively. Similarly when pure pesticides treated with APCP treatment degradation was in the range of 2.43-36.35, 4.71-26.81, 2.78-44.84 and 7.22-42.94%, respectively. Microorganisms *E. coli*, *S. typhi*, *E. aerogenes* and *S. aureus* were spiked on cumin seeds and treated with UV-C showed 3.48, 3.25, 3.20 and 5.24 log reductions at 3 cm distance for 24 min, respectively. When pure culture of microorganisms were treated with UV-C, 6.10, 6.30, 5.70 and 7.25 log reductions were observed at the same respective distance and treatment time. Degradation of quinalphose, profenofos, chlorpyrifos and ethion residues in cumin seeds by UV-C treatment was in the range of 4.05-16.19, 17.26-33.50, 18.14-42.82 and 4.11-40.90%, respectively. Profenofos and chlorpyrifos residues treated with UV-C treatment degradation was in the range of 77.90-99.43 and 36.92-82.72%, respectively. Quinalphos and ethion were completely removed at 3 cm distance for 24 min exposure time. Different decontamination and degradation rate was observed depending on type of the bacterial culture and type of pesticides. An extended time was required to complete decontamination of microorganisms and pesticide residues in cumin seeds. Overall, this study suggests that APCP and UV-C can be employed for treatment of fresh foods, without adversely affecting their quality parameters.



Anitha N.
(2018-2020)

ENCAPSULATION OF ESSENTIAL OIL FROM CRYOGROUND DILL SEED



Dr. R. V. Prasad

Abstract

Dill seed is also known as “sowa”, is an annual herb cultivated throughout India. The essential oil of dill seed is rich in monoterpenes like carvone and limonene and are extensively used in food, pharmaceutical and cosmetics as well as for aromatherapy. Extraction of dill seed essential oil with higher bioactive compounds can be achieved by grinding of dill seed at sub zero temperature. Encapsulation of essential oil can be useful to prevent loss of volatile compounds and preserve them for further use in food fortification and medicinal purposes. Dill seed cultivar of Gujarat Suva-2 variety was used in the present study. Physicochemical characteristics of dill seed and solvent extracted dill oil was carried out. Cryogenic grinding of dill seed was carried out using liquid nitrogen at predefined temperatures (0 ° to -80°C), feed rate (6, 7 and 8 kg/h) and sieve size (0.8 and 1.0 mm). For optimization, observations such as grinding time, liquid nitrogen consumption, energy consumption, particle size and essential oil content were taken. Optimized conditions for cryogenic grinding of dill seed were -60 °C temperature at 6 kg/h feed rate and sieve size of 0.8 mm to obtain superior quality of dill seed powder. GC-MS analysis showed 27.63 % carvone and 7.21 % limonene in the essential oil from optimized dill seed powder. Encapsulation of essential oil of optimized dill seed powder was carried out with different carrier materials. Polymers namely gum tragacanth, maltodextrin, agar agar and gelatine at concentrations of 0.50 %, 1.00 % and 1.50 % were used to partially replace sodium alginate. 1 g of dill seed essential oil was added to each solution along with 100 µl of TWEEN 20. These oil-alginate-polymer mixtures were sprayed into a 5 % calcium chloride solution with continuous agitation. The beads formed were filtered and oven-dried at 40 °C for 24 h. Particle size and moisture content of encapsulated powder ranged from 35.01 to 44.07 µm and 2.01 to 3.94 %, respectively. The optimized polymeric blend for dill seed essential oil was sodium alginate-agar agar at a ratio of 75:25 with an encapsulation efficiency of 79.40 %.



Atul Kansatwad
(2018-2020)

EVALUATION OF BIOGENIC AMINES IN MILK AND SELECTED FERMENTED MILK PRODUCTS



Dr. B. H. Joshi

Abstract

Biogenic amines (BA) in food is emerged as one of the main concerns for the food illness which constitute a potential public health concern because of their toxicological and physiological effects. BA represents a group of toxic compounds, with low molecular weight which are structurally related to alkaloids. These amines play important physiological roles in plants and animals. The consumption of foods containing high concentrations of biogenic amines has been associated with health hazards. BA are generally found in fermented foods and beverages of both animal or plant origin. It is especially detected in foods with high protein content which includes fish and fish products, meat and meat products, eggs, and dairy products. They are released when proteins are microbially/enzymatically hydrolyzed. Dairy products especially cheeses are one of the foods with highest biogenic amine content. Several factors such as the type of raw milk, the use of starter cultures and the conditions and time of the ripening process contribute significantly to the production of BA formation. Milk and selected fermented milk products were studied for the assessment of presence of BA. These products except raw milk were belong to well-known brand and procured from local markets of Anand, Gujarat. The technique used for the analysis of biogenic amines was High Performance Thin Layer Chromatography (HPTLC). The presence of biogenic amines such as histamine, tyramine, tryptamine, spermine, spermidine, cadaverine and putrescine were detected by UV visualizer of HPTLC system. It was observed that histamine, spermidine and tryptamine were present in the raw as well as pasteurized cow and buffalo milk but were within the safe limit of consumption. However, the pasteurised milk found to show low concentration tryptamine than the raw milk. Cheese was found to contain histamine spermidine and tryptamine throughout the storage study up to 120 days. All cheese samples shown same pattern of the various BA production and were found to be within the safe limit for consumption. None of biogenic amines were found to be present in the samples of curd and lassi. Present investigation revealed presence of BA in raw milk, pasteurised milk and all variety of cheese indicates a serious concern. Therefore, monitoring of these BA during processing as well as proper handling of these products from the production to consumption is very important to ensure safety.

