Value added products from rice bean

Legumes have a very important place in human diet. Rice bean [Vigna umbellata (Thumb.)Ohwi & Ohashi] is used for human consumption in the form of dhal. The scientists at Department of Human Development, Home Science College and Research Institute, Madurai and Directorate of Extension Education, Tamil Nadu Agricultural University, Coimbatore, India have investigated possibilities of increasing the utilization of rice bean for food and industrial purposes. Recipes were standardized by using 100% of the bean or incorporated with cereals and millets. The moisture, protein, total soluble solids, total and reducing sugars, crude fibre, zinc, copper, manganese and iron of whole rice bean and its dhal and anti-nutritional factors like tannin, phytic acid and flatus compound for the whole bean, cooked whole bean, sprouted bean, raw dhal and cooked dhal were estimated. The protein content of whole rice bean and dhal was 19.5 and 17.5%, respectively. Tannin content in sprouted bean was reduced by 94% compared to unsprouted bean. Whole rice bean when cooked or sprouted or converted into dhal the phytic acid content was reduced by 74%. By using whole bean, dhal and flour, recipes such as sundal, pulikulambu, ball curry, fried ball, snacks, sweets and supplementary foods along with cereals and millets were prepared and evaluated for consumer acceptability. All the prepared products had higher acceptability in terms of colour, texture, flavour and taste [Parvathi S and Kumar VSF, Value added products from rice bean, Vigna umbellata, J Food Sci Technol, 2006, 43(2), 190-193].

Effect of synthetic antioxidants on storage stability of Khoa

Khoa is a popular indigenous semi-solid milk product which is prepared by thermal evaporation of milk to 65-70% solids in an open pan. The food value of khoa is very high as it contains fairly large quantities of protein, fat, lactose and bone-forming minerals, especially calcium. It is usually used for direct consumption or as a base material for sweets preparation in the Indo-Pak sub-continent. Storage life of khoa is only two to three days, under ambient conditions and 15-20 days under refrigerated conditions. Though khoa is prepared in great abundance, no measures have been made to increase its storage life. Since, the temperature during summer is very high in the Indo-Pak sub-continent, methods for increasing the storage life of khoa will be very beneficial. Thus, researchers at Food and Biotechnology Research Centre, PCSIR Laboratories Complex, Lahore, Pakistan carried out studies to improve the storage life of khoa using synthetic antioxidants. Effect of synthetic antioxidants on storage stability of freshly prepared khoa was evaluated. Free fatty acids (FFA), peroxide value (POV) and iodine values (IV) were used to assess the development of rancidity during 30 days of storage of khoa at 25 and 45°C. Butylated hydroxy anisole (BHA) and butylated hydroxy toluene (BHT) were added to freshly prepared khoa to extend the storage life. After 30 days of storage at 45°C, freshly prepared khoa containing 200 ppm of BHA and BHT showed lower values of FFA (0.066%, 0.058%) and POVs (23.0 and 21.0 meq/kg) than the control samples (FFA 0.320%, POV 127 meq/kg). Iodine values of khoa sample containing 200 ppm of BHA and BHT were 67 and 69 after 30 days storage at 45°C. However, iodine value of a khoa sample without antioxidant (control) after 30 days of storage at 45°C was 30. Similarly, khoa samples treated with 100 ppm of BHA, along with 100 ppm of BHT, showed FFA value (19.0%), POV (0.049 meq/kg) and iodine value (72) after storage for 30 days at 45°C. These results illustrate that synthetic antioxidants inhibited the development of rancidity during storage of khoa. Therefore, storage life of khoa can easily be extended for 30 days by the addition of BHA and BHT [Rehman Zia-ur and Salariya AM, Effect of synthetic antioxidants on storage stability of khoa – a semi-solid concentrated milk product, Food Chem, 2006, 96(1), 122-125].
Soybean (*Glycine max* Merrill) is a rich source of protein and lipid and has many nutraceutical properties. For the promotion of soy based products the scientists at SPU Centre, Central Institute of Agricultural Engineering, Bhopal, India developed vegetarian *tofu kabab*. The basic constituents were soy *tofu* (obtained from soy milk processing plant) and Bengal gram (*Cicer arietinum* Linn.) *dhal* in proportions of 50: 50, 60: 40, 70: 30 and 80: 20 (fresh weight basis). Other ingredients per 100g were: 25g corn flour, 10g bread crumbs, 10g onion, 2g green chilli, 1g red chilli, 2g coriander leaves, 1g ginger and 1g garlic. Salt was added to taste and refined oil was used for shallow frying. Bengal gram *dhal* was mixed with ginger and garlic and cooked in pressure cooker for 5 minutes and ground to a paste. The gravy like product was cooled and added with *tofu*, condiments and spices and then thoroughly mixed. Oval shaped uniform size *kabab* (3cm × 6cm) were prepared and layered with wheat semolina and then subjected to shallow frying until golden brown coloured *tofu kabab* products were obtained.

The proximate composition analysis revealed the presence of protein; carbohydrate and crude fibre contents decreased respectively 6-19%, 11-36% and 3-26% with increase in the proportion of *tofu* while lipid contents did not change. Total bacterial count (TBC) and yeast and mould increased with storage period up to 5 days. The microbial safety of the product was assured due to TBC (2-4×10³) and yeast and mould (12-14/g) when stored under refrigeration for 3 days. The product with 60:40 combination was most acceptable with sensory score of 7.3 out of 9 [Deshpande Sumedha, Dubey Kalpana and Jha Krishna, Soy based vegetarian *kabab* and its quality evaluation, *J Food Sci Technol*, 2006, 43(2), 151-153].

Preparation of biscuits from wheat and quality protein maize

The demand for processed food is increasing rapidly especially snacks and biscuits. Utilization of high protein material is recommended to overcome the severe effect of protein malnutrition at low-cost. Accordingly, considerable interest has developed in protein rich biscuits which are convenient, inexpensive and ready-to-eat. Recently, maize germ cake, a by-product of wet and dry milling having 24% good quality protein with higher biological value has been processed into edible PDMGC (Processed Defatted Maize Germ Cake). In addition to this, quality protein maize (QPM) having amino acids balance with higher protein : energy ratio to utilize more protein by the body, have been developed worldwide.

The scientists at Directorate of Maize Research, Cummings Laboratory, Indian Agricultural Research Institute, New Delhi, India prepared two types of wheat flour and quality protein maize based biscuits with and without PDMGC supplementation and compared with wheat flour based biscuits standard. These biscuits were subjected for protein quality, *in vitro* protein digestibility (IVPD), shelf-life and organoleptic studies. Both protein quality and quantity improved in wheat flour and wheat flour + QPM based biscuits with supplementation of PDMGC at the cost of slight decrease in IVPD. Although less increase in acid values and moisture contents were found to improve the shelf-life in both types of biscuits after PDMGC supplementation than without PDMGC supplemented biscuits, respectively which show improvement in keeping quality under ambient conditions during 60 days of storage [Gupta HO and Singh NN, Preparation of wheat and quality protein maize based biscuits and their storage, protein quality and sensory evaluation, *J Food Sci Technol*, 2005, 42(1), 43-46].
Wheat, maize and rice are used as sources of energy and protein in the human diet throughout the world. These cereal grains are usually stored in jute bags and earthen pots under adverse conditions of temperature and moisture in Pakistan. Storage effects on nutritional quality of commonly consumed cereal grains were studied by researchers at Food and Biotechnology Research Centre, PCSIR Laboratories Complex, Lahore, Pakistan. Freshly harvested wheat, maize and rice grains were stored at 10, 25 and 45°C for six months. A significant decrease in pH and an increase in titrable acidity was observed during storage of these three cereal grains at 25 and 45°C. A gradual decline in moisture, total available lysine and thiamine contents was observed during storage. Total available lysine contents decreased by 6.50% and 18.5% in wheat, 14.3% and 20.7% in maize and 23.7% and 34.2% in rice during six months of storage at 25 and 45°C, respectively. Six months storage of rice, maize and wheat grains at 25 and 45°C resulted in reduction of thiamine contents by 16.7% and 29.2%, 17.2% and 24.1% and 21.4% and 29.5%, respectively. About 36.4-44.4% decrease in total soluble sugars at 45°C and 9.30-31.8% increase in total soluble sugars were observed at 10 and 25°C during six months storage of these cereal grains. Protein and starch digestibilities of cereal grains also deceased during six months of storage at 25 and 45°C. No significant change in nutritional quality was observed during storage of cereal grains at 10°C. In view of these facts, it is suggested that cereal grains (wheat, maize and rice) should not be stored above 25°C in order to minimize nutrient losses during storage [Zia-Ur-Rehman, Storage effects on nutritional quality of commonly consumed cereals, Food Chem, 2006, 95 (1), 53-57].

Due to its nutritional composition and satisfactory functional properties, lupin flour can be used in the production of fermented foods. In addition, there is an increased use of plant-derived ingredients as sources of vegetable protein in the formulation of food products such as dairy and meat analogues. They can be added to pasta, crisps, bread, biscuits and cakes and used for fine bakery and confectionery. The addition of up to 10% lupin flour improves water-binding, texture, shelf-life, aroma and nutritive value. Therefore, lupin has attracted interest, worldwide, as a potential high protein food ingredient suitable for human consumption. However, lupins contain flatulence-causing factors, known as α-galactosides or the raffinose family of oligosaccharides (RFOs) that range from 7 to 15% of raw seeds. Many investigations have been carried out to develop treatments in order to reduce or remove the content of α-galactosides and to enhance the nutritional quality of lupins. Researchers from Spain conducted studies to evaluate the effect of α-galactoside extraction on different nutritive parameters (protein, fat, ash, dietary fibre, soluble carbohydrates, starch, vitamins B1, B2, E and C) and antinutritional factors (α-galactosides, inositol phosphates and trypsin inhibitor activity) of different varieties of white (Lupinus albus Linn.) and yellow lupin (L. luteus Linn.).

Functional lupin seeds from two different cultivars of white and yellow lupin each were obtained by extraction of α-galactosides. In lupin seeds, α-galactosides were effectively removed and processed seeds contained very low amounts of flatulence causing factors (~0.5-1%). Protein, fat and starch contents showed high retention in processed seeds (up to ~130%). Sucrose and soluble dietary fibre, however, decreased significantly as a result of
Despite growing interest in the health aspects of whole grain products, good sensory properties still remain a key priority as a consumer choice criterion. Processing could have negative or positive effects on bioavailability of some nutrients, but good organoleptic characteristics are a prerequisite for the consumption of whole grains. Processing must, first of all, provide products that have suitable form and good sensory properties. Thus researchers at UAE and Canada investigated pasting properties of starch and protein in cereals and were able to identify significant differences between cereals in starch peak, breakdown and setback processing and retentions ranging from 10% to 60%, depending on the variety studied. Vitamins B1, B2, E and C were also reduced. Trypsin inhibitor activity was detected only in yellow lupin cultivars and inositol phosphate content was modified slightly after extraction. In summary, the functional lupin seeds, with low contents of \( \alpha \)-galactosides, are a product of nutritional importance due to their high protein content, dietary fibre and fat contents as well as acceptable levels of thiamin, riboflavin and vitamin E. Their flour can be incorporated as a functional ingredient in a wide range of foods and feedstuffs with no risk of flatulence problems [Martínez-Villaluenga C, Frias J and Vidal-Valverde C, Functional lupin seeds (\textit{Lupinus albus} L. and \textit{Lupinus luteus} L.) after extraction of \( \alpha \)-galactosides, \textit{Food Chem}, 2006, \textbf{98} (2), 291-299].

### Preparation of dietary fibre from coconut-kernel

The residue or press cake obtained as byproduct in coconut oil extraction units can be further processed into coconut flour and used as a source of dietary protein and fibre. The dietary fibre in coconut flour can be further concentrated by removal of residual fat, proteins and sugars. These fibre isolates can be used further to variety of products such as high-fibre biscuits, cookies, bread and dietary fibre-tablets.

During experiment for the preparation of dietary fibre from coconut kernel, the scientists at Department of Food Science and Technology, Mahatama Phule Agricultural University, Rahuri, Maharashtra, India and Coconut Research Institute, Bandirippuwa Estate, Lunuwila, Sri Lanka, extracted the dried coconut kernels in KOMET DD 85 oil expeller to separate oil while the residue was ground to produce coconut flour. Extraction of this flour successively with petroleum ether, dilute sodium hydroxide (\( \text{pH} 13 \)) and boiling ethanol (80% v/v) removed, respectively, 97% of the residual fat, 94% of proteins and 92.4% of sugars with concomitant increase in neutral detergent fibre (NDF) by 2 fold, acid detergent fibre (ADF) by 1.8 fold, hemicellulose by 2.6 fold and cellulose by 1.5 fold in resultant coconut fibre. The NDF was the major component of the fibre product. An ingredient formula containing 20% replacement of refined wheat flour (\textit{maida}) by coconut dietary fibre isolate was standardized to prepare acceptable cookies. Substitution of wheat flour with coconut dietary fibre isolate increased the NDF content in cookies from 0.87 to 6.1% [Yalegama LLWC and Chavan JK, Preparation of dietary fibre from coconut kernel, \textit{J Food Sci Technol}, 2006, \textbf{43}(5), 491-492].

### Pasting properties of starch and protein in cereals

Despite growing interest in the health aspects of whole grain products, good sensory properties still remain a key priority as a consumer choice criterion. Processing could have negative or positive effects on bioavailability of some nutrients, but good organoleptic characteristics are a prerequisite for the consumption of whole grains. Processing must, first of all, provide products that have suitable form and good sensory properties. Thus researchers at UAE and Canada investigated pasting properties of starch and protein of barley (\textit{Hordeum vulgare} Linn.), pearl millet (\textit{Pennisetum glaucum} Linn.), rye (\textit{Secale cereale} Linn.) and sorghum [\textit{Sorghum bicolor} (Linn.) Moench] whole grain meals, individually and in blends with wheat flour, the basic ingredient in making many staple foods, using a Rapid Visco Analyzer (RVA). The whole grain meals were blended with either hard or soft wheat flour and processed into bread, cake, cookie or snack products. The products were then evaluated with regard to physical properties and acceptability. Significant differences were observed between cereals in starch peak, breakdown and setback processing and retentions ranging from 10% to 60%, depending on the variety studied. Vitamins B1, B2, E and C were also reduced. Trypsin inhibitor activity was detected only in yellow lupin cultivars and inositol phosphate content was modified slightly after extraction. In summary, the functional lupin seeds, with low contents of \( \alpha \)-galactosides, are a product of nutritional importance due to their high protein content, dietary fibre and fat contents as well as acceptable levels of thiamin, riboflavin and vitamin E. Their flour can be incorporated as a functional ingredient in a wide range of foods and feedstuffs with no risk of flatulence problems [Martínez-Villaluenga C, Frias J and Vidal-Valverde C, Functional lupin seeds (\textit{Lupinus albus} L. and \textit{Lupinus luteus} L.) after extraction of \( \alpha \)-galactosides, \textit{Food Chem}, 2006, \textbf{98} (2), 291-299].
Coating and films have been used for many decades to protect food from microbial attack and to prevent water loss during storage. Consumer demands higher quality and longer shelf-life in foods, while reducing disposal packaging material and increasing recycle ability. In this regard, considerable research has been reported on edible films, which have many advantages over synthetic films. A study was conducted at Department of Food Science and Technology, College of Agriculture, Isfahan University of Technology, Isfahan, Iran to extract protein from lentil (Lens culinaris Medic.) seed and to prepare edible film from the protein and to determine mechanical, optical and barrier properties of lentil protein concentrate (LPC) film. The film was prepared from LPC (5 g/100 ml water) and glycerine (50%, w/w of LPC). Hunter colour value ($L$, $a$ and $b$), tensile strength, percentage elongation at break ($E$), puncture strength, water vapour permeability (WVP), moisture content after conditioning at 50% RH and 25°C for 48 hours and total soluble matter after immersion in water, were measured. In regard to WVP, in spite of difference in film thickness and relative humidity of experiment in different studies, lentil protein film is comparable with other protein films. Characteristics of the lentil protein-based edible films were comparable with other edible protein films. LPC film had more red and less yellow colour; it seems that the film had good mechanical properties and water vapour permeability in concomitant with good solubility.

Lentil protein not only has a medium nutritional value but also the protein is a good source for edible film formation and, therefore, application of the film can be suggested. Lentil protein concentrate film is strong and elastic and has a good moisture barrier property along with acceptable physical integrity, as its TS value is comparable to that of other edible films as well as its % $E$ value is higher than that of cellophane. Good puncture strength of LPC film indicates its suitable cohesiveness, whereas its WVP value is higher than that of corn and wheat protein films. However, this shortcoming can be improved by further works to find the best protein/plasticizer ratio along with cross-linking treatments of lentil protein films. The characteristics of the lentil protein-based edible films were comparable with other edible protein films, such as soy, pea and whey protein in terms of tensile strength, elongation, moisture barrier property and water solubility. The new film products may exploit the utilization of lentil protein. Regarding colour, the film was red to brown with semi-transparency, so can be used for packaging of foods which are sensitive to light [Bamdad Fatemeh, Goli Amir Hossein and Kadivar Mahdi, Preparation and characterization of proteinous film from lentil (Lens culinaris), Food Res Int, 2006, 39(1), 106-111].

**Edible film from lentil**

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Preparation of recipes from Amaranthus fresh and dried leaves powder

Consumption of green leaves has always been recommended by medical practitioners for the supplement of vitamin A, iron, calcium, ascorbic acid, riboflavin, folic acid and many other minerals. Amongst various edible leafy vegetables consumption of amaranthus is very low. Looking to the nutritional value of amaranthus leaves, the scientists at Department of Foods and Nutrition, CCS Haryana Agricultural University, Hisar, India conducted studies to develop products from fresh and dried amaranthus leaves and to evaluate their nutritional qualities. During experiment amaranthus (*Amaranthus tricolor* Linn.) leaves were washed, blanched in boiled distilled water for 10-15 second and dried at room temperature for 1-2 hours; surface water was removed by spreading on filter paper followed by drying in hot air oven at 40±5°C for 4-6 hours. The dried leaves were ground in Cyclotech mill of 60 mesh size to fine powder. This powder was stored in polythene bags in a dessicator at room temperature for further use. Various products were developed from fresh and dried leaves powder which include *pakora*, *vada*, *narmakpara* (from fresh leaves), *kurmura*, biscuit and cake. The products were analyzed for moisture, protein, ascorbic acid, β-carotene, total iron, ionizable iron, *in vitro* iron, copper, manganese and zinc. Protein content of all the products ranged from 7.4 to 17.9%. Ascorbic acid was higher in products prepared with fresh amaranthus leaves. β-Carotene content was maximum in *narmakpara* (3685 mg/100g) containing amaranthus leaf powder. Total iron ranged from 7.9 to 12.4 mg/100g. Ionizable iron and *in vitro* iron (as % of total iron) were found to be 57 and 27% in biscuit [Singh G and Kawatra A, Development and nutritional evaluation of recipes prepared using fresh and dried amaranthus (*Amaranthus tricolor*) leaves, *J Food Sci Technol*, 2006, 43(5), 509-511].

Toasting reduces antinutritional factors of Pigeon Pea

Legumes are second only to the cereals in their importance to human and livestock nutrition. Pigeon pea, *Cajanus cajan* (Linn.) Millsp. is a widely cultivated legume in many tropical countries. It contains a moderate level of crude protein, about the same as in cowpea. Although pigeon pea is widely consumed, the nutrient availability to the human gut is constrained by certain inherent antinutritional factors (trypsin inhibitor, cyanide and phytic acid). These antinutrients are generally located in the germ and peripheral areas of the seed. Many processing methods have been shown to reduce the level of these antinutrients. Boiling, fermentation and cooking are the common methods of processing most legumes, but the effects of toasting on antinutrients have not been reported on pigeon pea. Some researchers suggested that toasting between 80 and 120°C could adequately reduce antinutritional factors to tolerable limits. The scientists at Department of Home Economics and Nutrition Michael Okpara University of Agriculture Umudike, Nigeria conducted studies to determine the effects of dry heating (toasting) on the antinutrients and the functional properties of pigeon pea flour. Determination of functional properties was also aimed at the possibility of increased use of pigeon pea flour in food formulations. These results demonstrated that toasting did not adversely affect the nutrient contents of the pigeon pea flour. It also revealed that toasting up to 100°C for one hour had positive effects on some functional properties and greatly reduced the antinutritional factors, reducing cyanide by 66%. Values for functional properties showed that toasting slightly increased water and oil absorption capacities of the flour, while emulsion activities and stability, foam capacities and stability, and bulk density were significantly reduced (*P*<0.05). This study has also shown that when heat processed, pigeon pea flour can be incorporated into various food formulations [Onimawo IA and Akpojovwo AE, Toasting (Dry Heat) and Nutrient Composition, Functional Properties and Antinutritional Factors of Pigeon Pea (*Cajanus Cajan*) Flour, *J Food Proc Pres*, 2006, 30(6), 742 -746].
**Food**

### Development of mushroom snacks

*Pleurotus* mushrooms are very good source of lysine and tryptophan contents but have shelf-life of only 3-4 days under ambient conditions; also the longer storage results in loss of turgidity and development of dark colour. To avoid wastage of these mushrooms scientists have developed several value added food products. The scientists at Department of Food Science and Technology, G.B. Pant University of Agriculture and Technology, Pantnagar, India have developed *Pleurotus* mushroom *mathri* (a deep fat fried snack) of fairly good sensory qualities. Using 10g *Pleurotus* powder, 90g refined wheat flour (*maida*), 2.0g salt, 0.5g baking powder, 235ml water and 20.0g hydrogenated vegetable oil (HVO). Levels of mushroom powder, baking powder and HVO were optimized using response surface methodology and central composite rotatable design. The blends were prepared separately. Fried *mathri* was subjected to sensory evaluation. The expansion on frying and fat contents were determined. Optimization studies gave one recipe corresponding to each quality parameter. Thus 5 optima levels of 3 ingredients were obtained. Recipe based on optimized colour score (9.1g of *Pleurotus* powder, 0.6g baking powder and 26.03g HVO) gave the highest level of *Pleurotus* powder and was taken as compromised optima. Variations of 0.5 g in *Pleurotus* powder content in this recipe did not make any significant change in their scores. (colour: 8.0-8.7, appearance: 8.3-8.5, flavour: 8.3-8.6, texture: 8.0-8.5, and OAA: 8.1-8.5). Water activity of optimized *Pleurotus mathri* (3.5% moisture db) was 0.22; its moisture content should be kept below 4.2% during storage [Kumar Sanjeev, Nath Nirankar and Tyagi RK, Development and evaluation of *Pleurotus* mushroom *mathri*, *J Food Sci Technol*, 2006, 43(5), 501-504].

### Nutritional cake from blanched and malted pearl millet

Pearl millet [*Pennisetum typhoides* (Burm. f.) Stapf & C. E. Hubbard] grains are in demand for their nutritive value, comparable to other staple cereals like wheat and rice. But their utilization is limited due to presence of antinutrients, poor digestibility of protein and carbohydrates. However, various processing treatments like blanching and malting are known to affect the chemical composition and improve nutritive value of products. The scientists at Department of Foods and Nutrition, CCS Haryana Agricultural University, Hisar, India investigated the effect of blanching and malting of pearl millet as well as on addition of soybean flour on nutritive value of cakes prepared from them. During experiment four types of cakes were formulated using 50% blanched pearl flour (BPMF) + 20% soybean flour (SF) + 30% refined flour (RF) (Type I), 75% BPMF + 25% RF (Type II), 50% malted pearl millet flour (MPMF) + 20% SF + 30% RF (Type III) and 75% MPMF + 25% RF (Type IV). Type I and Type II cakes were liked moderately whereas type II and IV cakes were liked slightly by the judges. Addition of SF increased the protein, fat, ash, calcium and phosphorous contents of cake. Cake prepared from MPMF had lower protein, fat and ash contents whereas crude fibre contents was significantly higher in cakes as compared to that prepared from blanched flour [Singh G, Sehgal S and Kawatra A, Sensory and nutritional evaluation of cake developed from blanched and malted pearl millet, *J Food Sci Technol*, 2006, 43(5), 505-508].

### Paneer-like product from mushrooms

White button mushrooms [*Agaricus bisporus* (J. E. Large) Sing] is the commonly used edible mushroom in India but it is highly perishable. After harvesting they are to be consumed within 4-6 hours but sometimes transportation does not allow to do so. Therefore, the scientists at Department of Food Science and Technology, G.B. Pant University of Agriculture and Technology, Pantnagar, India evaluated possibilities of utilizing spent mushrooms and mushrooms stipe by freeze texturization process. Development of a ‘paneer-like product’ was envisaged by the scientists...
for increasing the shelf-life of these mushrooms. Initial standardization of processing steps showed that grinding blanched (2 min, boiling water) mushrooms for 30 second, washing slurry with water, adding 2.0% salt, keeping for 20 min, pressing slurry, freezing pressed cake for 72 hour at –18°C and thawing under ambient conditions gave a good quality ‘paneer-like product’. The product quality was further improved by using cryoprotectants—sorbitol, sodium tripolyphosphate (STP) and skim milk powder (SMP). Their levels were optimized using response surface methodology. Compromised optimized levels were: 0.5452% sorbitol, 0.2155% STP and 0.0218% SMP. Freeze texturized button mushrooms contained 86.73% moisture, 0.78% protein, 0.36% fat, 5.23% fibre, 0.76% ash and 6.14% carbohydrates. Yield was 61% of spent mushroom. The product had a shelf-life of 36 hours at ambient temperature (32±3°C) which was extended to 10 days at 5°C and 4 days at 37°C when it was treated with 2.0% potassium sorbate and packed in LDPE (Low Density Polyethylene) films [Misra Deepika, Shah NS and Nath Nirankar, Freeze texturization of spent mushroom, J Food Sci Technol, 2006, 43(5), 496-500].

Rutin content in buckwheat food materials and products

Rutin is a secondary plant metabolite that antagonizes the increase of capillary fragility associated with haemorrhagic disease, reduces high blood pressure, decreases the permeability of the blood vessels and has an anti-oedema effect, reduces the risk of arteriosclerosis and has antioxidant activity. The presence of rutin in buckwheat (Fagopyrum esculentum Moench) plants and foods is one of the main reasons for the production of different kinds of buckwheat foods. The most popular food is buckwheat noodles, very popular in Japan, China and Italy, made from buckwheat flour-water dough. Increasing awareness and care for health has led to the production of high quality food products. Other products made from buckwheat are buckwheat floral honey, green buckwheat tea, buckwheat sprouts, buckwheat vinegar, buckwheat beer, buckwheat spirit and fresh green plant parts used as a vegetable. The rutin content of buckwheat products was compared to the rutin content in their raw materials, in order to evaluate their value for producing functional foods by researchers at Slovenia and Japan. There is much less rutin in noodles (78 mg/kg, dwb — dry weight basis), than in the dark buckwheat flour (218 mg/kg, dwb) from which they are produced. One of the possible explanations is the presence of the rutin degrading enzyme. In raw (uncooked) groats there is 230 mg/kg (dwb) of rutin and in precooked groats, 88 mg/kg (dwb). In buckwheat beer and vinegar there is a negligible content of rutin. Buckwheat leaf flour contains about 2700 mg/kg (d.w.b.) rutin, and is thus a suitable material for enriching functional foods, giving it the potential for preventive nutrition. Thus, buckwheat materials have potential, at least in regard to the rutin content, as a functional food. However, attention should be paid, during processing, to the factors which may lower the rutin content [Kreft I, Fabjan N and Yasumoto K, Rutin content in buckwheat (Fagopyrum esculentum Moench) food materials and products, Food Chem, 2006, 98(3), 508-512].
Optimization of *sattu* making process

Barley (*Hordeum vulgare* Linn.) is the world’s fourth most important cereal after wheat, rice and maize. Because of its excellent nutritional value barley is the best suitable cereal for high energy functional foods. In summer a soft food called *sattu* is prepared in slurry or paste from ground powder of roasted barley or wheat and Bengal gram or Chickpea (*Cicer arietinum* Linn.) or barley alone with sugar or salt in milk or water.

The scientists at Centre of Food Science and Technology, CCS Haryana Agricultural University, Hisar, India conducted studies on optimization of processing parameters for barley and chickpea *sattu*. During experiment the grains (50 g) were soaked up to 48 hours in 100 ml water in a 200 ml beaker at room temperature. Excess water was drained off from the soaked grains. Loosely bound water was removed by keeping soaked grains in 4 folds of newspaper print at room temperature and gain in weight of grains was recorded. After draining, the grains were spread in 5 mm thick layers and dried at room temperature to an optimum moisture content of about 30 per cent. Roasting was carried out in an indigenous designed roaster. Roasted grains were dehulled. The dehulling yield (DY) and dehulling efficiency (DE) on winnowed dehulled grains were determined. The results revealed that soaking of grains increased the roasting time with improved flavour and colour development. About 30% moisture in the grain is most suitable for barley and chickpea. Roasting for about 5 minutes is best for both grains. A dehulling efficiency of about 75% for barley gave dehulling yield of 92% with acceptable product. Flour extraction rate (FER) of 76% with 60 mesh yielded a better product. DE, DY and FER for chickpea were 90, 74 and 85%, respectively. Protein and reducing sugars increased on roasting whereas moisture, crude fibre, ash and non-reducing sugars reduced. Replacement of barley flour with chickpea in *sattu* was acceptable at all levels but a 40% substitution may be optimum from nutritional point of view [Dabas Deepti, Singh Mahabir and Singh Rajendra, Processing of barley and chickpea for making *sattu*, *J Food Sci Technol*, 2005, 42(1), 60-64].

Nutrient retention in microwave cooked germinated legumes

The effects of germination on the cooking quality and nutrient retention in pressure and microwave-cooked Bengal gram (*Cicer arietinum* Linn.), Green gram (*Phaseolus aureus* Roxb.) and Horse gram (*Dolichos biflorus* Linn.) were studied by researchers at Department of Studies in Food Science and Nutrition, University of Mysore, Manasagangotri, Mysore, India. Ungerminated legumes (UGL) and germinated legumes (GL) cooked in a microwave oven, and under pressure were analyzed for moisture, protein, ash, iron, thiamin, ascorbic acid, *in vitro* protein digestibility (IVPD) and starch digestibility (IVSD) and bioavailable iron. Results revealed that *microwave cooking* required more water and time than did pressure cooking. The effect of germination and method of cooking on nutrient retention varied, depending on nutrient and severity of heat treatment. Microwave cooking caused 36-57% reduction of ascorbic acid while pressure cooking caused 10-30% loss. The IVSD in raw samples ranged from 18.4% to 22.1% in UGL and 33.6% to 43.6% in GL. Cooking of UGL and GL, by both methods, increased the starch digestibility three fold. The IVPD of raw UGL ranged from 64.6 to 66.2% and that of GL was 72.4-73.9%. In cooked UGL the IVPD ranged from 70.9 to 82.3% and, in GL, from 78.4 to 84.2%, showing a significant difference in cooking methods only in UGL. The iron bioavailability ranged from 11.5 to 18.7% in raw UGL while it was 18.3-20.6% in GL. GL had a higher content of thiamin and ascorbic acid, higher protein and starch digestibility and bioavailable iron, even after cooking [Khatoon Naveeda and Prakash Jamuna, Nutrient retention in microwave cooked germinated legumes, *Food Chem*, 2006, 97(1), 115-121].