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National Seminar on

EMERGING TRENDS IN PROCESSING AND VALUE ADDITION OF SMALL MILLETS

Thamukkam Ground, Madurai

22nd and 23rd September, 2017

Abstracts

Organized by

Post Harvest Technology Centre

Tamil Nadu Agricultural University, Coimbatore

& DHAN Foundation, Madurai

Under the aegis of the

Scaling up Small Millet Post harvest and Nutritious Food Products Project

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TECHNICAL SESSION 1

HEALTH AND NUTRITIONAL BENEFITS OF SMALL MILLETS

TECHNICAL SESSION 2

MACHINERIES USED IN PRIMARY AND SECONDARY PROCESSING

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Technical Session 1

Health and Nutritional Benefits of Small Millets

S1-L

HEALTH AND NUTRITIONAL BENEFITS OF MINOR MILLETS

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Nutritional quality of food is the most important parameter for maintaining human health and complete physical well being. Nutritional well being is the driving force for development and maximization of human potential; this increases the economy of the country.

India is facing a double burden of nutrition. Dietary quality of food should be taken into consideration for maintaining overall maximization of human health and fitness to solving the problem of deep rooted malnutrition and emerging problems with over nutrition and imbalance of nutrition.

The green revolution in India promoted the major crops like rice and wheat to fight the hunger and this has found a prominent place in the food basket both at the urban and rural households and has suppressed the production and consumption of millets, which once considered the staple food.

The importance of nutrition as a foundation for healthy overall development is underestimated and given a second place. Now-a-days people are very conscious about their healthy living practices to prevent and overcome metabolic disorders and life style diseases. Diversification of food production and consumption must be encouraged both at national and household level.

Numerous nutritious and medical functions of millets have been reported. These are underutilized and neglected crop because of little knowledge to people and some critical problems like lower cooking quality, taste and low bioavailability of millets. These problems can be solved and make them valuable as food for poor families to combat malnutrition and affluent population to combat or prevent the lifestyle disorders.

The major millets like the Pearl millet and corn have a significant place in the Indian cuisine, but the group of small/minor millets represented by six species, namely finger millet, little millet, kodo millet, foxtail millet, barnyard millet and proso millet need more attention (Exceptional is finger millet).

Minor millets are good source of macro and micro nutrients. These are also alkaline forming grain that is gluten-free recommended for celiac disease. Alkaline based diet is often recommended to achieve optimal health. In developing country, cereal-based foods have low bioavailability of minerals like iron, zinc initiate critical problem for infants and young children. Food processing techniques are used to enhance nutritional quality, improve the digestibility and bioavailability of food nutrients with reducing anti-nutrients.

Millets are also rich sources of photochemicals and micronutrients, play many roles in the body immune system. Millets have nutraceutical properties in the form of antioxidants which prevent deterioration of human health such as lowering blood pressure, risk of heart disease, prevention of cancer and cardiovascular diseases, diabetes, decreasing tumor cases etc. Other health benefits are increasing the time span of gastric emptying, provides roughage to gastro intestine.

There is an urgent need to revive and promote these minor millets. Awareness studies and extension activities should be carried out to popularize these 'Nutri cereals'. Improvised processing techniques should be used to get the maximum bioavailability of the nutrients present in these nutrient dense foods.

A substantial work has been carried out by the scientists and people in the related field in developing value added food products and functional foods with minor millets. It's a great initiative. Great care and caution has to be taken to benefit the end consumer.

As we are progressing towards the technology sound mechanised world, our eating habits and food selection have altered. We are moving away from the traditionally cooked foods to ready to eat or ready to cook processed foods to minimize our time in cooking and consuming. Hence extra caution should be taken on food safety and food labelling which is crucial to the consumer as well as the producer or manufacturer.

Even in the feeding the young child families are moving away from giving traditional home cooked foods to the food mixes available in the market. Molecular basis of waxy starch has been identified in foxtail millet, proso millet, and barnyard millet to facilitate their use in infant foods.

Media play a very pivotal role in the selection of foods by the consumers. A word of caution to the producers, manufacturers and the consumers - use/get the right information to select your foods.

S1-OP1

DEVELOPMENT AND EVALUATION OFMILLET AND GREENGRAM BASED ROTI MIX

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Legumes have been known as ''a poor man's meat''. They supply protein, complex carbohydrates, fibre and essential vitamins and minerals to the diet, which are low in fat and sodium and contain no cholesterol. Due to this, the Indian population depend on pulses as a main source of proteins, vitamins and minerals in the daily diet. Chick pea, pigeon pea, mung bean, urad bean, lentil and field pea are the importance pulses of significant dietary importance. The present research on development and evaluation of millet and greengram based roti mix were carried out to develop the nutritious composite flours from ragi, green gram, soy flour, lentil and spinach powder. Composite flour at different ratio *viz*., ragi flour and roasted green gram flour (T_1-70:30) and ragi flour, roasted lentil flour, soy flour and spinach powder (T_2-50:30:10:10) were found to be most acceptable. The proximate content of protein, fat, crude fibre and carbohydrate of roti mix T_1 was 12.31, 1.3, 3.75 and for roti mix T_2 was 67.41 and 11.48, 1.3, 3.46, and 55.39 g per 100g respectively. The calcium, phosphorus and iron content were found to increase on supplementation of green gram, soy flour and spinach powder. Organoleptic evaluation revealed that the developed roti mix were highly acceptable and also suitable nutritious snack food for all age group.

S1-OP2 PHYSICAL PROPERTIES AND NUTRITIONAL CONTENT OF RAW AND POWDERED MILLET VARIETIES

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Millets are the staple food of the millions inhabiting the arid and semiarid tropics of the world. They are distributed in most of the Asian and African countries and parts of Europe. The grains of small millets are the cheap source of protein and total minerals and they provide an opportunity to improve the health of people, reduce health care costs and support economic development in rural, tribal and hilly communities. An attempt was made to determine the physical properties of whole grains and chemical properties of whole grains and millet flour. The millet varieties selected for the study were Ragi Co15, Samai Co4, Varagu Co3, Thenai Co6 and Kuthiraivali Co2. The 1000 grain weight of the above millets was 3 g, 2.32 g, 6.3 g, 2.48 g and 3.06 g respectively and the 1000 grain volume of the selected millets was 5ml, 5ml, 7ml, 4ml and 6ml. The length and breadth of the grains were as 0.15 cm and 0.15 cm for Ragi Co15, 0.21 cm and 0.18 cm for Samai Co4, 0.29 cm and 0.25 cm for Varagu Co3, 0.22 cm and 0.15 cm for Thinai Co6& 0.21 cm and 0.17 cm for Kuthiraivali Co2. The bulk density of Ragi Co15, Samai Co4, Varagu Co3, Thenai Co6 and Kuthiraivali Co2 were 0.6, 0.464, 0.9, 0.62 and 0.51 g/ml respectively. Moisture content, protein, fat, fibre, total minerals and starch content was determined for whole grains and flour of selected millet varieties. In whole grains, the moisture content was in the range of 9.00 ± 0.32 to 12.3± 0.66 percent, starch in the range of 52.88 ± 0.32 to 64.96 ± 0.57 mg, fat 0.9 ± 0.12 to 4.4 ± 0.26 percent, fiber 3.6 ± 0.66 to 8.2 ± 0.35 percent, total minerals 1.4 ± 0.22 to 3.5 ± 0.46 percent and protein 6.1 ± 0.37 to 12.7 ± 0.54 percent. For powdered samples, the moisture content was in the range of 8.9 ± 0.54 to 12.1 ± 0.24 percent, starch 52.96 ± 0.25 to 66.43 ± 0.65 mg, fat 0.8 ± 0.33 to 4.1 ± 0.82 percent, fiber 3.5 ± 0.47 to 8.7 ± 0.76 percent, total minerals 1.2 ± 0.38 to 3.7 ± 0.52 percent and protein 5.9 ± 0.44 to 12.9 ± 0.28 percent. It was observed that there was no significant difference in the value of nutritional content of both whole grains and powdered samples.

S1-OP3 DEVELOPMENT OF MULTIGRAIN TRADITIONAL SNACK

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Traditional foods give us good and unique taste, which is also healthy for human beings. Among those, *Chikki* plays an important role in ready to eat traditional sweet products, which is preferred by all age groups of our population. The preferences for multigrain products have been increased due to changing lifestyle which provides them with their expected nutrients in a single food. All ages of population, mainly children prefer multi-nutrient snack more than the multi-nutrient food. Hence, *chikki* was prepared with multigrain providing multi-nutrients. Small millets are also known as miracle grains because of their high nutritive value. Among those, foxtail millet (*Setaria italica)* is the second-most widely planted species of millet and has a good nutritional profile which is comparable to staple cereals as rice and wheat in terms of protein, fiber, minerals and vitamins. The present study focuses on developing multigrain traditional snack i.e. *chikki* by incorporating foxtail millet along with pumpkin seed, flax seed, ground nut, almond and black sesame seed. The overall sensory quality determined on 9 point hedonic scale indicated that developed *chikki* incorporating foxtail millet (20%) with pumpkin seed (20%), flax seed (10%), ground nut (20%), almond (5%) and black sesame seed (5%) was the preferred one with the sensory score of 8.3 against commercial groundnut *chikki* and other five different combinations. The proximate composition of the developed *chikki* was found to be moisture 0.15g, protein 14.78g, fat 16.6g, fiber 4.1g and minerals like iron 9.67mg, calcium 269.9 mg, potassium 839.75mg, phosphorus 565.1mg, magnesium 462.92 mg which was superior when compared to commercial groundnut *chikki*. The shelf life of the developed *chikki* was found to be stable for 20 days at RT when packed in plastic box.

S1-OP4

STUDIES ON ENHANCING THE SHELF LIFE OF DE-HULLED MILLETS

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Millets are remarkable in their nutritive value and are nearly 3-5 times superior to rice and wheat. The millets have to be stored safely for its continuous supply throughout the year. The shelf life of de-hulled millet is limited as the bran contains oil which produces rancidity during storage. A study on storage of de-hulled kodo millet, little millet and foxtail millet was conducted to enhance the shelf life. The experiments were conducted by using four different storage methods *viz.*, vacuum packaging, modified atmosphere packaging, hermetic storage and flexible packaging (Super grain bag). The effect of storage on biochemical and nutritional qualities were analyzed. The results revealed that starch content, protein content, dietary fibre and colour of the de-hulled millets remained same under all the storage conditions. It was observed that there was an increase in the temperature and decrease in the relative humidity during the storage period. The free fatty acid, total phenols and moisture content changed during storage. It was observed that the de-hulled millets stored in hermetic storage was comparatively better than the other storage methods as it had retained higher amount of phenols with less production of free fatty acids. The starch content of kodo millet, little millet and foxtail millet stored in hermetic storage ranged from 62.91 to 63.69 g, 58.50 to 61.36 g and 60.06 to 61.36 g per 100 g of sample. The moisture content decreased from10.2 to 8% (w.b.), 10.7 to 8% (w.b.), 10 to 8.4% (w.b.), respectively for kodo millet, little millet and foxtail millet. The phenolic content ranged from 347.4 to 360.93 mg, 123.73 to 141.72 mg, 94.36 to 101.93 mg per g of sample for kodo millet, little millet and foxtail millet respectively. The free fatty acid ranged from 0.05 to 0.13 g, 0.05 to 0.16 g, 0.05 to 0.12 g of oleic acid per 100 g of sample for kodo millet, little millet and foxtail millet respectively. It was evident that the de-hulled millets can be stored effectively for more than four months in hermetic storage.

Keywords: Dehulled millets, MAP, hermetic storage, biochemical quality, total phenols

S1-OP5

PEARL MILLET RESISTANT STARCH- A FUNCTIONAL FIBRE

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Pearl millet (*Pennisetum glaucum* (L.) is a staple food that supplies a major proportion of calories and protein. This study was conducted to investigate the structural properties of starch from pearl millet CO 10 variety. Different isolation methods affected the structural property of starch. The pearl millet starch was isolated with Sodium azide (T1), Sodium metabisulphate & lactic acid (T2), and Mercuric chloride (T3). XRD analysis was carried out to know the crystallinity of starch and it revealed that three methods of isolated starch possess a typical A- type crystallinity with strong reflection at 2 theta about 15, 20, 25 and 27 degree. The highest crystalline degree was observed in (T3) (27 %). Crystallinity induced the great amount of resistant starch formation in pearl millet starch and it also decreased the fraction of rapidly digestible starch (RDS) whereas the level of slowly digestible starch(SDS) was increased, consequently reducing In vitro starch digestibility. Resistant starch act as a functional fibre and it could be incorporated into various food products to increase the fiber content.

Key words: property of X-ray diffraction (XRD), crystallinity, isolation methods

S1-PP1 BIOACTIVE COMPOUNDS AND HEALTH PROMOTING PROPERTIES OF MILLETS: A REVIEW

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Bioactive compounds from different agricultural food products have attracted great interest from food industries and researchers for their health promoting functions such as antioxidant, antiaging, anti-inflammatory, anticancer performance, etc. Bioactive compounds are extra nutritional elements that typically occur in small quantities in foods. These substances are beneficial to human health but are not essential for the human body. The majority of bioactive compounds of whole-grains are present in the bran/germ fraction of millet grains. These fractions of whole-grain may therefore help in reducing the risk of chronic diseases. Bioactive compounds in whole-grain millets have not received as much attention as in fruits and vegetables. Epidemiological studies have shown that regular consumption of whole grains and wholegrain products is associated with reduced risks of various types of chronic diseases such as cardiovascular diseases, type 2 diabetes and some cancers. Whole-grain millets or foods made from whole-grains contain all the essential parts, the bran, the endosperm and rarely germ in contrast to the refined grains, in which the bran and the germ of the grains are removed during the milling process. Whole-grain millets are rich sources of fiber, vitamins, minerals and phytochemicals. These health benefits are achieved through multifactorial physiological mechanisms including antioxidant activity, mediation of hormones, enhancement of immune system and facilitation of substance transit through the digestive tract, butyric acid production in the colon, and absorption and/or dilution of substances in the gut. The recent evidence suggests that the complex mixture of bioactive components in wholegrain millet foods may be more health beneficial than individual isolated components.

S1-PP2 PHYSICOCHEMICAL PROPERTIES OF MILLET BASED COMPOSITE FLOUR MIX

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The composite flour mix containing sorghum, wheat semolina, rice and green gram flour of four different combinations was prepared and studied the physicochemical properties of composite flour mix. The composite flour mixes were analyzed for its physic chemical properties such as pasting properties, moisture, protein, fat, crude fibre and amino acid profile using standard analytical procedures. Results indicated that all the chemical parameters were increased significantly at ($p<0.01$) with increased proportion of composite flour. The lysine and methionine content of composite flour mix were higher than control flour. Glutamic acid content was highest in composite flour compared to other amino acids. The viscosity parameters were increased substantially with the addition of composite flour mix compared to control flour. The higher peak viscosities in both control and composite flour indicate larger water binding capacities of the starches in mixes. The pasting temperature was lesser in composite flour (88.5ºC) than control (90.15ºC). The time from onset of pasting to peak viscosity was similar for both control and composite flour (5.13 min). Thus the incorporation of millets with cereals and pulses significantly modified the properties of composite flour in such a way that it was found suitable for the preparation of pasta products.

S1-PP3 FUNCTIONAL, NUTRITIONAL AND HEALTH BENEFITS OF FINGER MILLET (*ELEUSINE CORACANA*)

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Finger millet otherwise called as ragi is one of the ancient millet crops cultivated in several regions across in India. Finger millet is a rich source of carbohydrate, protein vitamins and minerals. Finger millet protein contains major fractions of prolamins which contains higher proportions of glutamic acid, proline, valine, isoleucine, leucine and phenylalanine and low lysine, arginine and glycine. Sulphur containing amino acids in finger millets are higher (methionine and cystine) as compared to milled rice. Potassium content is also high in finger mille mg / 100 g. Finger millet has also contains high calcium (350 mg/ 100 g). Milled finger millet is rich in dietary fiber and micronutrients. Finger millet's fat consist oleic acid, linoleic acid, palmitic acid and traces of linolenic acid. Layers of seed coat of the finger millet contains tannins and polyphenols. Phenolic compounds (both free and bound forms) are present in very good amount in finger millet. Finger millet's leaves also contains several flavonoids such as orientin, isoorientin, vitexin, isovitexin, saponarin, violanthin, lucenin-1 and tricin (antitumor and anti-leukemic properties). Finger Millet has antioxidant, antimicrobial and antihypocholestrolemic, antifungal and antibacterial, antidiabetic (type 2 diabetes), nephroprotective, wound healing and anticataractogenesis properties. Millet processing techniques are also used to enhance nutritional quality, improve the digestibility and bioavailability of essential nutrients also reducing anti-nutritional contents. Some food processing techniques of finger millets are decortications, milling, soaking, cooking, germination, fermentation, malting, popping etc. Combination of germination and malting could be effectively used for the preparation of variety of healthy and nutritious finger millets based food products such as infant formula, complementary and therapeutic foods to combating severe health problems.

S1-PP4 ANTIDIABETIC PROPERTY OF FINGER MILLET

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Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia, resulting from insufficient or inefficient insulin secretion, with alterations in carbohydrate, protein and lipid metabolism.Regular consumption of finger millet is known to reduce the risk of diabetes mellitus and gastrointestinal tract disorders and these properties were attributed to its high polyphenols and dietary fiber contents. The total phenolic compounds in finger millet, is about 85% benzoic acid and its derivatives like gallic acid, vanillic acid, syringic acid and cinnamic acid derivatives like ferulic acid, and the flavonoids are quercetin, Proanthocyanidins like condensed tannins. The beneficial effect of phenolics is due to partial inhibition of amylase and α- glucosidase during enzymatic hydrolysis of complex carbohydrates and delay the absorption of glucose, which ultimately controls the postprandial blood glucose levels. Beneficial effect of dietary fiber is usually attributed either to slower gastric emptying or formation of un-absorbable complexes with available carbohydrates in the gut lumen and these two properties might result in delayed absorption of carbohydrates and in the reduction of absolute quantity absorbed .Inhibitors like aldose reductase prevents the accumulation of sorbitol and reduce the risk of diabetes induced cataract diseases. Finger millet seed coat phenolics and dietary fiber content act as inhibitors, decreasing the postprandial hyperglycemia by blocking the action of enzymes like amylase, alpha-glucosidase needed for enzymatic hydrolysis of complex carbohydrates.Polyphenols act as inhibitors that inhibit the activity of digestive enzymes like amylase, glucosidase, lipases, pepsin,and trypsin . It conclude that finger millet is an wonderful grain having antidiabetic property.

Keywords: Fingermillet- phenolic compounds-dietaryfiber-enzymatic hydrolysis-antidiabetic property

S1-PP5 BARNYARD MILLET: A POWERHOUSE OF NUTRIENTS

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Nutraceuticals are health enhancing physiologically active food components which are also called as phytochemicals. They play a key role as health protective and disease preventive agents and have tremendous impact on the health care system. Barnyard millet (*Echinochloa frumentacaea*) is a fast growing multipurpose crop, thrives well even under adverse agro-climatic conditions. Studies revealed that the barnyard millet grain contains about 65% carbohydrate, majority of which is in the form of non-starchy polysaccharide and dietary fibre. This helps in the prevention of constipation, lowering of blood cholesterol and slow release of glucose into the blood stream during digestion. Barnyard millet has been found to be most effective in reducing blood glucose and lipid levels. Research on barnyard millet revealed the dietary fiber content of barnyard millet was high (12.6%) including soluble (4.2%) and insoluble (8.4%) fractions. The high fiber content helps in preventing constipation, excess gas, bloating and cramping. Some varieties of barnyard millet have shown to contain high amounts of iron (18.6 mg in 100g of raw millet) which was the richest amongst all millets and cereal grains. Barnyard millet contains higher amount of tryptophan (58.35 to 78.89 μg/g), total carotenoids (36.72 to 50.79 μg/g), phenolic content (20.30 to 27.80 mg GAE/g) and α-tocopherol (23.69 to 30.94 μg/g) compared to the finger millet. Finger millet seeds contain about 10–13 folds higher calcium content and double amount of manganese content in comparison to barnyard millet seeds. Studies on bioactive constituents in barnyard millet proposed that it contains higher amount of polyphenols, tannins (3.25 to 3.96 mg/g) and orthodihydroxy phenol content (107.14 to 130.71 μg catechol/g) compared to finger millet which serve as good source of natural antioxidants. Hence incorporation of flour of barnyard millet and finger millet in different ratio may enhance the nutraceutical value of the processed food.

Keywords: Barnyard millet, carbohydrate, dietary fiber, phenolic content, orthodihydroxy phenol

S1-PP6

SMALL MILLETS-A FOOD FOR NUTRITIONAL SECURITY

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Millets serve as a major food component specifically among the non-affluent segments in their respective societies. Various traditional foods and beverages such as roti, bread (fermented or unfermented), porridge, snack and fast foods, baby foods, millet wine, millet nutrition powder etc are made up of millets. Highfibre content of millets makes the process of digestion slow, there by prolonging the supply of energy to the body. Fermented foods are easy to digest. The growth of healthy bacteria during fermentation weakens the anti-nutrients and enhances the nutrient availability. Fermented products naturally release the micronutrients required for our body. Celiac disease is an immune-mediated enteropathy triggered by the ingestion of gluten in genetically susceptible individuals. Millets are gluten-free, therefore an excellent option for people suffering from celiac diseases and gluten-sensitive patients often irritated by the gluten content of wheat and other more common cereal grains. Millets are good sources of magnesium that is known to be capable of reducing the effects of migraine and heart attack. Millets are rich in phyto-chemicals containing phytic acid which is known for lowering cholesterol. Finger millet may prevent cardiovascular disease by reducing plasma triglycerides in hyperlipidemic rats. The diabetes preventing effect of millets is primarily attributed to high fibre content. The beneficial effect of soluble dietary fibre may be mediated through slower absorption and digestion of carbohydrates. This leads to reduced demand for insulin. Insoluble dietary fibre tends to shorten intestinal transit time, which in turn permits lesser time for carbohydrates to be absorbed. The complex carbohydrates present in millets break down to simple sugars at a slow rate, and get absorbed at a slower rate, allowing slow rise in blood glucose. Millets are also rich sources of phytochemicals and micronutrients. Phytochemicals such as phenolics (bound phenolic acid-ferulicacid, free phenolic acid-protocatechuic acid), lignans, β-glucan, inulin, resistant starch, phytates, sterols, tocopherol, dietary fiber and carotenoids are present in millets. Ferulic acid is very strong antioxidant, free radical scavenging and anti-inflammatory activity. Antioxidants significantly prevent tissue damage and stimulate the wound healing process.

Keywords: Millets-phytochemical-disease prevention-dietary fibre-phenolics-antioxidant activity.

S1-PP7

NUTRITIONAL AND HEALTH BENEFITS OF SMALL MILLETS

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A number of different small-grained cereal grains are collectively described as 'Millets'. Millets are one of the oldest cultivated foods known to humans. Two main groups of millets are major millets (sorghum and pearl millet) and small millets based on the grain size. Off late, the classification is also an indication of the area under these crops. Both major and small millets have traditionally been the main components of the food basket of the poor people in India. The group of small millets is represented by six species, namely finger millet (*Eleusine coracana* (L.)), little millet (*Panicum sumatrance*), kodo millet (*Paspalum scrobiculatum* (L.)), foxtail millet (*Setaria italica* (L.)), barnyard millet (*Echinochloa frumentacea* (L.)) and proso millet (*Panicum miliaceum* (L.)), representing the area grown in that order. Small millets are more nutritious compared to fine cereals. Finger millet is the richest source of calcium (300-350 mg/100 g) and other small millets are good source of phosphorous and iron. The protein content ranges from 7 to 12% and fat content from 1 to 5.0%. The millet protein has well balanced amino acid profile and good source of methionine, cystine and lycine. These essential amino acids are of special benefit to those who depend on plant food for their protein nourishment. The millet grain contains about 65% carbohydrate, a high proportion of which is in the form of non starchy polysaccharides and dietary fibre which helps in prevention of constipation, lowering of blood cholesterol and slow release of glucose to the blood stream during digestion. Millet grains are also rich in vitamins *viz*., thiamine, riboflavin, folin and niacin. Millets vary largely in composition of carbohydrates as proportion of amylose and amylopectin content vary from 16-28% and 72-84%, respectively. These millets contribute towards balanced diet, and can hence ensure nutritional security more easily through regular consumption along with keeping the environment safe as they are low input crops mostly adapted to marginal lands. Development of health foods and their commercialization should receive focused attention to promote the millets among the urban elite, which would lead to reduction in life-style related disorders.

Keywords: Millets, methionine, amylose, amylopectin

S1-PP8 MILLETS –NUTRICEREALS

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Cereal grains are the most important source of the world's food and have a significant role in the human diet. As one of the most important drought-resistant crops, millet is widely grown in the semiarid tropics of Africa and Asia and constitutes a major source of carbohydrates and proteins for people living in these areas. It is mainly consumed in India and Africa. It is an important cereal because of its excellent storage properties and the nutritive value is higher than that of rice and probably, wheat. It is also a good source of micronutrients like Calcium, Iron, Phosphorus, Zinc and Potassium. Due to the presence of anti-nutrients in grains such as tannins and phytates, these micronutrients are less bioaccessable. Poor iron bio availability in millets were due to their high tannin content which adversely affect the nutritional quality of the grains. Other group of anti-nutritional factor, phytate or phytic acid, It is the main phosphorus store in mature seeds significantly influences the functional and nutritional properties of foods. Phytic acid has a strong binding capacity, readily forms complexes with multivalent cations and proteins in millets which make the minerals insoluble at physiological pH. Hence, phytate binding renders several minerals biologically unavailable to the humans. However, these anti-nutrients can be removed by different processing techniques viz., germination, fermentation, dehulling etc. Malting of the grain significantly reduces the phytin phosphorus in millets which was accompanied by significant increase in ionisable iron and soluble zinc, thereby improving the availability of these two elements. Processing technologies can be used for improving the nutritional characteristics of millets which is the main challenge in promoting use of millet as staple food. Moreover processing techniques can be employed for developing novel nutritious food products from millets.

Keywords: Antinutritional factors, phytochemicals and processing

S1-PP9 BARNYARD MILLET "THE NUTRI CEREAL"

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Barnyard millet is a multipurpose crop which is cultivated for food and fodder. It has an excellent rejuvenating capacity compared to other cereal crops. It is a fair source of protein, which is highly digestible and is an excellent source of dietary fibre with good amounts of soluble and insoluble fractions. The carbohydrate content is low and slowly digestible, which makes the Barnyard millet a nature's gift for the modern mankind. As compared to un-germinated seed, germinated seeds contain high protein, low unsaturated fatty acids, low carbohydrate, mineral content and vitamin. GABA is currently an interesting compound which increased during germination via protein metabolism of seed components. Barnyard millet recorded a highest proportion of soluble fibre of about 6.0 - 6.5 per cent. Nutritionally, Barnyard millet is an important crop which contains good amount of digestible protein, and both soluble and insoluble fractions of dietary fiber. Polyphenolic compounds such as flavonoids, phenolic acids, and DPPH (radical scavenging activity) which are of great interest for their radical-scavenging activity are expected to be effective in the prevention of many diseases. Lowest level of tannin 102.96mg and higher concentration of calcium, phosphorous, manganese and magnesium were recorded in Barnyard millet. It is most effective in reducing blood glucose and lipid levels compared to other millets. Thus, for the health conscious consumer of the present world, minor millet especially Barnyard millet is perhaps one more addition to the proliferating list of healthy foods, owing to its nutritional superiority. With the modern people chasing ready to cook food items, the nutritive minor millets are being faded into oblivion. It is springtime for potential minor millets like Barnyard millet to be woven in the fabric of daily diet.

S1-PP10 MILLET- A FOOD MEDICINE

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Millet grains have substantial benefits as a draught resistant crop, yield good productivity in the areas with water scarcity, possesses remarkable edible & nutritive values, and ease of processing & food manufacturing. Agriculture & Food security policymakers of developing countries should give due attention in promoting the research work & projects for studying the processing, food manufacturing, improvement in nutritive values and potential health benefits of the millet grains to promote their utilization as food in respective countries. FAO reported that traditional food processing (such as decortications, milling, germination, fermentation, malting, roasting etc.) is commonly used for preparation of food products of millets improve their edible, nutritional, and sensory properties. Lower incidences of diabetes have been reported in millet-consuming population. The phenolic present in millets inhibits like alpha-glycosidase, pancreatic amylase reduce postprandial hyperglycemia by partially inhibiting the enzymatic hydrolysis of complex carbohydrates. Millets are also rich sources of phytochemicals and micronutrients. Phytochemicals such as phenolics (bound Phenolic acid-ferulic acid, free Phenolic acid-protocatechuic acid), lignans, β-glucan, inulin, resistant starch, phytates, sterols, tocopherol, dietary fiber and carotenoids are present in millets. Millets are known to be rich in phenolic acids, tannins, and phytate that act as "antinutrients" However; these antinutrients reduce the risk for colon and breast cancer in animals. Millet foods are also characterized to be potential prebiotic and can enhance the viability of probiotics with potential health benefits. This study emphasized on nutraceutical properties of millets and the application of millets as alternative cereals potentially healthy to elaborate therapeutic food products like protein and energy rich diet, diet for diabetes, gluten free diet, CVD, etc.

Keywords: Phytochemicals, Anti-nutrients, Probiotic & prebiotic, Gluten-free.

S1-PP11 HEALTH BENEFITS OF MINOR MILLETS

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India occupies the first position in major production of minor millets. The lack of diversity in dietary habit among the peoples creates malnutrition and the prevalence of non-communicable diseases in higher rate. Minor millets perform well in marginal environments and have superior nutritional properties, including high micronutrient and dietary fiber content with low glycemic index. Millets are highly nutritious and has antioxidant properties which provide balanced nutrition. Since millet is gluten-free, it is an excellent option for people suffering from celiac diseases. It is also useful for people who are suffering from atherosclerosis, diabetic and heart disease. Pearl millet consists of secondary metabolites like tannins, flavonoids, terpenoids, glycosides, phenol and steroids. Based on its pharmacological properties, it can cure several health problems like cancer, diarrhea and cardiovascular diseases. Fingermillet is rich in calcium, iron, magnesium, potassium, zinc and it contains typical bioactive components like amino acids, iron, calcium, phosphorus, fibre and vitamins. The grain rich in phytochemicals includes phytic acid, which lowers cholesterol level in the human body. Protein concentrate of foxtail millet and proso millet significantly elevates the plasma adiponectin and HDL cholesterol levels, improves glycemic responses and act as a potential therapeutic intervention in type 2 diabetes. It also has protective effects against D-galactosamin-induced liver injury. Several potential health benefits such as preventing cancer and cardiovascular diseases, reducing tumor incidence, lowering blood pressure, risk of heart disease, cholesterol, and rate of fat absorption, delaying gastric emptying, and supplying gastrointestinal bulk were reported in millets. Therefore more attention and consideration should be shown on minor millets to avoid various health problems for developing healthy society.

S1-PP12 RAGI (*ELEUSINE CORACANA)* – A POTENTIAL MILLET FOR BETTER HEALTH AND VALUE ADDITION

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Millets have substantial benefits as a drought resistant crop used to produce good yield with minimum fertilizers and insecticides application especially in the water scarcity areas. Millet is an alkaline forming grain that is gluten-free substitute for celiac patients (autoimmune disease caused due to gluten). Finger millet (*Eleusine coracana*) popularly known as ragi, one of the minor cereals, is known for its polyphenol and dietary fiber contents. Ragi also contains high content of calcium, dietary fiber and phyto - chemicals such as antioxidants. Ragi is also having many specific health beneficial properties than any other food groups such as anti-diabetic, anti-tumerogenic, anti-atherosclerogenic, antioxidant, antimicrobial properties, anti-mutagenic, anti- oestrogenic, anti-carcinogenic and anti-inflammatory, antiviral platelet aggregation inhibitory activity that might potentially be beneficial in preventing the incidence of various diseases. In recent days, various convenient value added products are also developed by considering health benefits of the consumers. The emerging food products prepared from ragi are extruded products (pasta, noodles and vermicelli), bakery products (bread and cake), ready mixes (soup mix, adai mix and weaning food mix), ragi pakora (finger millet fritter), germinated products (weaning and supplemented foods), traditional foods (murukku, athirasam) and so on. These ragi and ragi based products are playing major role in the establishment of millets based enterprises and providing profit making avenue for the farmers, marching towards a better health of the society.

S1-PP13 NUTRACEUTICAL AND THERAPEUTIC FAVOR OF FINGER MILLET *(Eleusine coracana L.)* IN HEALTH

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Millets are one of the oldest foods known to humans and cultivated since time immemorial. India is the largest producer of many types of millet. Finger millet belongs to the family *Poaceae* and is commonly known as ragi or madua in India. Globally, 12% of the total millet area is under finger millet cultivation. It perceived as a potential "super cereal" being one of the most nutritious among all major cereals. As it is often grown and consumed in developing countries by small-hold farmers, it is often referred to as a "crop for the poor" or a "famine food". It has higher anti-oxidant capacity due to presence of phenolic content, flavonoids (catechin, gallocatechin, epicatechin, procyanidin dimmer) as well as enzymatic (catalase, superoxide dismutase, glutathione peroxidase, and glutathione reductase) and non-enzymatic antioxidants (glutathione, vitamin E and C). Finger millet incorporated diet prevents mucosal ulceration, exhibit the anti-ulcerative property, serum cholesterol. The phenolics present in finger millet seed coat inhibit the intestinal-glucosidase and pancreatic amylase thus helps in controlling postprandial hyperglycemia. Finger millet seed coat also contains polyphenols and quercitin inhibits Aldose Reductase (AR) enzyme activity it exhibit inhibitory property. Protocatechuic, caffeic, gallic, parahydroxybenzoicacid, polyphenols, and quercitin from finger millet inhibited the growth of pathogenic bacteria. Finger millet germinated based food showed an improvement in hemoglobin status. Gallic acid, quercitin and crude polyphenol extract from finger millet act as potent inhibitor of phospholipaseA2 from snakevenom, it indicates the potential application against inflammatory disorders. Finger millet fermented drink by *Lactobacillus* used as a therapeutic agent against diarrhea. Solid state fermentation of finger millet results in the production of anti-hypercholestrolemic metabolites (pravastatin, lovastatin, monacolin J, pravastatin and mevastatin).

Keywords: Finger millets, phenolic, Flavonoids and Anti-hypercholestrolemic metabolites

S1-PP14

NUTRACEUTICAL PROPERTIES OF FOXTAIL MILLET (*SETARIA ITALICA*)

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Millets are a traditional staple food of the dry land regions of the world. In India, millets contribute 10 percent to the country's food grain basket. They are nutri-cereals which are highly nutritious which includes protein, essential fatty acids, dietary fibre, B-Vitamins, minerals such as calcium, iron, zinc, potassium and magnesium. The foxtail millet is also known as Italian millet. It has been recorded that foxtail millet has many nutritious and medical functions. The yellow seeded cultivars of foxtail millet, medicinally used as digestive, emollient and stomachic. It is also used in the treatment of dyspepsia, poor digestion and food stagnancy in abdomen. This millet contains 12.3 per cent crude protein and 3.3 per cent minerals. Now a day the concept of food are changing from a previous emphasis on survival and hunger satisfaction to a current emphasis on the use of nutraceutical foods which promise to promote better health and well-being, thus helping to reduce the risk of chronic illnesses such as cardiovascular diseases, diabetics, cancers and obesity. Foxtail millet contributes to the significant supply of health-promoting phytochemicals like polyphenols, lignans, phytosterols, phyto-oestrogens, phytocyanins which act as antioxidants. The foxtail millet contains 47 mg/100 g of polyphenolics and 3.34 mg/100 g of tocopherol. Thus, foxtail millet may serve as a natural source of antioxidants in food applications and as a nutraceuticals and functional food ingredient in health promotion and disease risk reduction.

Keywords: Millets, nutraceutical, antioxidants, polyphenols and chronic diseases

S1-PP15 NUTRITIONAL AND HEALTH BENEFITS OF KODO MILLET (*PASPALUM SCROBICULATUM*)

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Kodo millet (*Paspalum scrobiculatum*) is an important crop in the Deccan plateau. It is cultivated in India and is generally confined to Gujarat, Karnataka and parts of Tamil Nadu. Kodo millet is also known as varagu, haraka and arakalu. The grain varies in colour from light red to dark grey. The fibre content of the whole grain is very high. Kodo millets are rich in B vitamins especially niacin, B6, folic acid, and excellent source of carbohydrates, protein, fiber as well as the minerals such as calcium, iron, potassium, magnesium and zinc. It also contains high amount of polyphenols, antioxidants, phytochemicals, tannins, and phytic acids. It is good for people who are gluten intolerant**.** *Regular consumption of kodo millet is beneficial for postmenopausal women suffering from signs of cardiovascular disease, like high blood pressure and high cholesterol levels.* Phytochemicals and phytic acid lowers cholesterol and also helps in reduction of cancer risks. Millet is one of the oldest nutritious grains and a good substitute to rice or wheat. Kodo millets can be used for traditional as well as novel foods. Kodo millets are being used as nutraceutical as they are rich in antioxidant which is much higher than that present in major cereal crops. Kodo millet is beneficial in curbing asthma, migraine, atherosclerosis and heart attack. The high fibre content in millets prevents gall stone formation. The whole grain consumption has health promoting effects like prevention of insulin resistance, heart disease, diabetes, ischemic stroke, obesity, breast cancer, childhood asthma etc. Because of the nutritional benefits of millets, they are also called as *'nutricereals'* and can be used as functional foods.

Keywords: Kodo millet, minerals, antioxidant and functional food.

S1-PP16 ANTIPROLIFERATIVE ACTIVITY OF PROSO MILLET (*PANICUM MILIACEUM L.*)

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Cell proliferation is the process that results in an increase of the number of cells. Uncontrolled proliferation is an important part of cancer development and progression. According to the world health organization cancer is a leading cause of death worldwide accounting for 8.8 million deaths in 2015. That is nearly 1 in 6 of all global death. Death from cancer worldwide are projected to continue rising with an estimated 13.1 million deaths in 2030. American institute for cancer research and word cancer research fund have estimated that 30-40 percent of all cancer can be prevented by appropriate diet, physical activity and maintenance of appropriate body weight. Proso millet is an important millet and a valuable component of the human diet. Regular and consistent consumption of proso millet is correlated with low incidence of cancer. The phenol content of proso millet is about 0.05-0.10 mg per 100 g of catechin equivalent, dry basis. The phenolic phytochemicals present in proso millet are ferulic acid, chlorogenic acid, syringic acid, caffeic acid and p-coumaric acid. Ferulic acid and chlorogenic acid are the predominant phenolic compounds found in the millet. The phenolic compounds have anti- prolific effect on the cancer cell line, inhibit DNA damage and induce the production of phase-2 detoxifying enzymes. The compounds that have been found to inhibit one or more pathway that contributes to proliferation. The phenol compounds have antiproliferative activities against human breast cancer cells and liver cancer cells.

S1-PP17 PHENOLIC PROFILES OF SMALL MILLETS

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In Asia and Africa, underutilized millet grains play a major role in the food security of millions of people. In addition to being a rich source of nutrients, millet grains have phyto chemicals, particularly phenolic compounds. Phenolic compounds are diversified groups of phytochemicals found in plant foods and is an important part of the human diet. Phenolic compounds in millets are found in the soluble as well as insoluble-bound forms. Phenolics which are extracted into aqueous-organic solvent mixtures are soluble phenolics. They include phenolic compounds existing in the free, non-conjugated form as well as phenolic compounds conjugated to soluble carbohydrates via ester (esterified) and ether (etherified) bonds. The insoluble-bound phenolic compounds are especially phenolic acids which are mainly esterified to polysaccharides providing cross-linking between cell wall polymers. Meanwhile, flavonoids exist mainly in the free form. Free phenolic acids are found in the outer layers of the kernel (pericarp, testa, and aleurone), whereas the bound phenolic acids are associated with the cell walls. Millets contain mainly free and conjugated forms of phenolic acids, which includes derivative of hydroxyl benzoic and hydroxyl cinnamic acids. Hydroxy benzoic acids derived from benzoic acid includes gallic, *p*-hydroxybenzoic, vanillic, syringic, and protocatechuic acids. The hydroxyl cinnamic acids include coumaric, caffeic, ferulic, and sinapic acids. In addition, several flavonoids, namely anthocynidins, flavanols, flavones, flavanones, chalcones, and aminophenolic compounds are also found in millets. Further, millet grain phenolics are bioaccessible, possess bioactivities against several pathophysiological conditions and may serve as potential natural sources of antioxidants in food and biological systems. The use of millets, as nutraceuticals and functional foods reduce health risk and overall wellness is warranted.

S1-PP18

THERAPEUTIC USAGES OF MILLET GRAINS - A REVIEW

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Millet grains are mainly used as animal and bird feed, but not used as human main food because of unawareness of people. These are consumed mainly by the inhabitants of semi-arid regions in Asia and Africa. Millet grains are known to be a drought-resistant crop, resistance to pests and diseases and having a short growing season as compared to other major cereals. Due to these characteristics, millet grains are receiving specific attention in the developing countries like India and some countries from Africa Continent in terms of utilization as a food. These are easily available and are cheap in cost. As compare to major cereals grains like wheat and rice, millets are found to be rich in complex carbohydrate, protein, calcium, iron, dietary fibre and antioxidants. Millets act as functional food as well as nutraceuticals. Obesity, diabetes and other chronic diseases are increasing day by day globally. Food containing complex carbohydrates with high fiber and health beneficial phytochemicals has been in demand to combat the above health issues. Wholegrain cereals food formulations are increasing worldwide because they are rich sources of phytochemicals and dietary fiber which offer positive effects on health. Millet grains contain anti-nutrients like tannins, phytates, polyphenols, trypsin inhibitors and dietary fiber. Polyphenols are considered as "life span essential". These have no known direct role in nutrition but have some health friendly properties like antioestrogenic, anti-mutagenic, anti-carcinogenic, antiviral effects, anti-inflammatory, platelet aggregation inhibitory activity that might be potential benefit in minimizing and preventing the incidence of diseases. Phytates, polyphenols and tannins of millet's foods can contribute to anti-oxidant activity that play an important role in health, aging and metabolic disease. Efforts should be made to educate people about the potential value of millets, including nutritional properties and health benefits, which will help in creating market demand providing millet grains an economical importance.

Keywords: Millet, chronic diseases, nutrients, anti-nutrients, therapeutic usages

S1-PP19

MILLETS: THE WONDER GRAINS – AS NUTRACEUTICAL

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Millets are the wonders seeds which posses excellent properties in relieving many chronic diseases and also life style diseases. Millets are filled with compounds such as polyphenols, flavanoids, resistant starch which have tremendous health benefits and thus can help in curing chronic diseases. Polyphenols – nowadays is termed as "life span essentials" due to their role in maintaining body functions and health throughout end phase of life. Polyphenols in millets are found to have anti estrogenic, anti mutagenic, anti carcinogenic, anti viral, anti inflammatory, platelet aggregation inhibitory activity which might be beneficial in minimizing and the preventing the incidence of diseases. Studies have pointed out that polyphenols, phytates and tannins in millets act as antioxidants which play an important role in aging and metabolic diseases. Millets are found to be a staple food for celiac patients as they are gluten free. Regular intake of millets is said to improve the hemoglobin levels in children. Antinutritional factors present in millet reduce the starch digestibility and its absorption and thus can lower the incidence of hyperglycemia in diabetes patients. Millet foods are also characterized to be potential prebiotic and can enhance the viability of probiotics with potential health benefits. Carbohydrates in millets are non- starchy polysaccharides which are barrier to digestion, delayed nutrient absorption, increasing fecal bulk, mobiity of intestinal contents, increased faecal transit time and fermentability properties lowering of blood lipids and prevention of colon cancer. The resistant starch (RS) complements the health benefits of the millet, also contributes towards dietary fibre. Resistant starch escapes the enzymatic digestion imparts beneficial effects by preventing several intestinal disorders. Millet oil could be a good source of natural oil like linoleic acid and tocopherols. The findings of various studies conducted thus reveal that millets can be considered as "food medicine".

Keywords: Polyphenols, antioxidant, resistant starch, phytates, tannins

S1-PP20 GLYCEMIC INDEX AND GLYCEMIC LOAD OF SPECIALLY DEVELOPED MILLETS & SOY PRODUCTS BASED FOOD ITEMS

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Millets and soy products based recipes (5 no's) were developed. The recipes were organoleptically evaluated for appearance, texture, aroma, taste and overall acceptability by thirty trained panel members using a five-point hedonic rating scale. Carbohydrate content of the food items for raw ingredients was assessed making use of the food composition table given by ICMR (Gopalan *et al.,* 2010) and "dietcal" software. Based on the weight and carbohydrate content, the portion size containing 50g of carbohydrate was determined. The energy, carbohydrate, protein, fat, total dietary fiber, calcium, iron, carotene, vitamin B1, B2 and C content in one portion (containing 50 g carbohydrate) of the standardized foods were also assessed making use of the above mentioned food composition table and "dietcal" software. Ten non-diabetic healthy adult volunteers were selected. On day I, fasting blood glucose levels were recorded. The glycemic response on administration of 50 g of the reference food (Glucose) after 30, 60, 90 and 120 minutes were also recorded. The same procedure was repeated after administering test foods on the following days. The Glycemic Index and Glycemic Load were estimated by the procedure given by Jennie Brand-Miller, 2004. All the five items developed were highly acceptable with respect to all the criteria. The energy value of the five food items ranged between 256 and 371 kcal for the portion size containing 50 grams of carbohydrate. The protein content ranged from 9 – 20.1grams. The calcium and iron content ranged from 62.9 to 248.7 mg and 2.8 to 8.8 mg respectively. The glycemic index of all the five foods were low ranging between 48 and 53 only. The glycemic load was found to be from 8 to 22.

Keywords: Millets, soy products, glycaemic load, glycaemic index, fasting blood glucose

S1-PP21

NOVEL SYNBIOTIC YOGHURT FOR THE DEVELOPING WORLD

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Small millets have the potential to contribute to food security and nutrition, but still these are underutilized crops. In developing country, occurrence of malnutrition and various health problems like obesity, diabetes, cardiovascular disease, cancer, celiac disease etc., are most prominent because of inadequate supply of nutrition. This is mainly due to the little utilized agricultural crops as food and unawareness of people and lack of knowledge to people. Agriculture and Food security policymakers should give due attention in promoting the research work and projects for studying the processing, food manufacturing, improvement in nutritive values and potential health benefits of the small millets to promote their utilization as food in respective countries. Most of the developing countries have already started working in the field of improvement of edible potential of small millet grains. Commonly small millets have nutraceutical properties in the form of antioxidants and also characterized to be potential prebiotic and can enhance the viability of probiotics with potential health benefits. Prebiotics are non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and activity of probiotic bacteria in the colon. Probiotics are "living microorganisms" which when administered in adequate amounts confer a health benefit on the host. Fermented small millet based milk products act as a natural probiotics which aid the existing flora or help repopulate the colon when bacteria levels are reduced by antibiotics, chemotherapy or disease. The combination of probiotics and prebiotics is known as Synbiotics. This study undertakes to develop a synbiotic yoghurt with the combination of probiotics and prebiotic which must be recognized as an important food and introduce the small millets as a nutritious food, fulfillment of the nutritional need of global population and combat malnutrition. The combination of probiotics and prebiotics in yoghurt becomes common practice to improve its nutritional properties. The symbiotic yoghurt serves as a functional food and good carrier for probiotic to gut and improve gut health with regard to a possible role to reduce the risk of diseases.

Keywords: Small millets, Prebiotic, Probiotics, Yoghurt, Fermentation

S1-PP22 PROSO MILLET – AWONDER MILLET

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Proso millet *(Panicum miliaceum)* belongs to one of the first cultivated plants which is more commonly known as white millet or hog millet. Recently, it has become a new alternative crop and new raw material for food production in many developed and developing countries. Also changes in climatic conditions can support the growth of this drought resistant plant. Millets have nutraceutical properties in the form of antioxidants which prevent deterioration of human health such as lowering blood pressure, risk of heart disease, prevention of cancer and cardiovascular diseases, diabetes, decreasing tumor cases etc. Other health benefits are increasing the time span of gastric emptying, provides roughage to gastro intestine. Millet products can be used as diets for patient with celiac diseases as the protein complex does not contain gluten forming proteins. Among the minor millets, proso millet has unique properties and health benefits. It contains carbohydrates, essential fatty acids and minerals like phosphorus, manganese, magnesium etc. It contains high amounts of calcium which is essential for bone growth and maintenance. It actually contains one of the most bioavailable sources of calcium found among food stuffs. This is especially useful for young children whose bones are in the growing phase and for old people for whom large amounts of calcium are required for proper bone maintenance and also to prevent the formation of gallstones. Proso millet is delicious as a cooked cereal and can also be popped like corn for use as a snack or breakfast cereal. Properly stored, whole millet can be kept safe for up to two years. Proso millet is a highly nutritious, healthy and versatile grain that would be worthy adding to anyone's diet.

Keywords: Proso millet, versatile grain, delicious millet.

Technical session 2

Machineries Used in Primary and Secondary Processing

S2-L

PERFORMANCE EVALUATION OF DIFFERENT DEHUSKINGMACHINES FOR KODOMILLET

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Abstract

Kodo millet like most of the other small millets resembles rice in grain morphology containing husk, bran and endosperm. The husk in this grain is strongly attached to the endosperm compared to rice and hence, pose problem in dehulling. A comparative performance of four types of cereal processing machines such as burr mill, rubber roll sheller, Victor millet mill model–I and Victor millet mill model–II @ were evaluated for dehulling kodo millet grain at 9, 9.5 and 10% initial moisture level. Among the four equipment used for dehulling kodo millet, the Victor millet mill model-II was found to be better with dehulling efficiency of 82.46-85.60%, milling recovery of 57.05-57.71%, head rice yield of 87.62-89.46% and lower broken yield of 10.52-12.37%at the initial moisture content of 9%.

Introduction

Millets are small grained cereals and the smallest of them include finger, foxtail, kodo, proso, little and barnyard millets. India is the largest producer of millets. These millets are predominantly rain fed crops and are cultivated in a wide range of soil and climate, especially in semi-arid regions because of their short growing season. Kodo millet is an indigenous cereal crop of India. It is commonly known as '*kodo'* in Hindi, *varagu* in Tamil, and *harka* in Kannada. In India, this crop is grown in over 0.7 million hectares with largest area in the state of Madhya Pradesh followed by Chhattisgarh. However, it is also grown in Maharashtra, Uttar Pradesh, Gujarat, Karnataka and Tamilnadu. The dehusked and polished grain may be cooked like rice or milled into flour for other uses. The kodo millet grain has unique nutritional properties, which are superior to rice and wheat in certain constituents. Little, kodo and Italian millets are richer in protein and fat constituents. The crude protein content of the kodomillet ranged from 7-12%, and the fiber from 7-9 % (Ramanathan and Naik, 1975).

The kodo millet has husk and bran over the edible endosperm. Traditionally husk and bran are separated by hand pounding. Kodo millet is toughest to process

where in, the grains are pounded 6-7 times in the traditional stone pounder. This involves laborious operations and drudgery. Good mechanical dehulling or polishing units suitable for processing of kodo millets are hardly available**.** Rajesh (2004) reported that the milling efficiency and head yield of little millet was higher in friction type polisher than burr mill. The husk (hulls) in these grains is closely and strongly attached to the endosperm compared to rice and hence, pose problems for dehulling. Considering the several disadvantages associated with traditional methods of dehusking kodo millet, identifying a dehulling machine for processing kodo millet is important.

Materials and Methods

A study was conducted to identify a suitable dehulling machine for kodo millet. Four different machines namely, burr mill, rubber roll sheller, Victor millet mill model- I and Victor millet mill model- II were tested for dehulling raw kodo millet.

Burr mill: The burr mill used for milling trails was a commercial machine withtwo 13.5" diameter emery stones and operated by a 2 hp single phase motor. The technical specification of the equipment is mentioned in Plate 1. The inner stone was stationary and was fixed with the body of the mill, while the outer emery stone was fixed on a horizontal rotating shaft powered by a motor. The power transmission from motor to machine was by v-belt through pulley system and the speed of rotation of moving stone was about 720 rpm. The machine consisted of a feed hopper and a regulator to regulate the desired feed rate of the input material. The grain was fed between the stones at the axial centre through the fixed stone and the flight welded on the shaft pushed the dehulling material like a screw conveyor. The grains were sheared between the two faces of emery stone resulting in dehulling of grains. The clearance between the stones could be adjusted by moving the rotating emery stone forward or backward by operating a screw wheel. The dehulled grain came out through an outlet provided at the side bottom of the milling chamber.

Rubber roll sheller: It consists of two rubber rolls rotating in opposite direction at different speeds. A feed roll feeds millets uniformly to the machine and is fed as thin layer between the rotating rolls. One of the roll is fixed while the other is adjustable to obtain desired clearance between them. The rolls are driven mechanically and the adjustable roll normally runs about 25% slower than the fixed one (1000 rpm). Difference in surface speeds of the rolls impart a shearing force on grain surfaces resulting in the opening and peeling of husk. The clearance between the rolls is adjusted to about half of the millet thickness and may be adjusted by judging the shelling efficiency. The technical specification of the equipment is mentioned in Plate 2.

*Victor millet mill model – I:*It is originally developed for dehulling little and foxtail millets with reasonable dehulling efficiency (approx. 80%). The main dehulling chamber just resembles a hammer mill. Specially designed high speed impeller hammers (with teeth) strip the hull off the millet grains that are caught between hammer tip and the serrated casing. The construction and operational speed are delicately balanced such that the millet grains are not powdered but only hulled. The milled grain along with husk ismade to fall down the dehulling section in zig zag manner during which the lighter husk is aspirated out allowing the relatively heavier product (millet rice) to exit through the outlet. Dehulling of kodo millet in this machine required multiple passes. The technical specification of the equipment is mentioned in Plate 3.

Victor millet mill model – II: The constructional features of this machine are very similar to Victor millet mill model- I expect that the machine operated at higher speed and the size of impeller and casing are bigger. The technical specification of the equipment is mentioned in Plate 4.

DehuskingProcedure: First, to obtain grains at various initial moisture contents, conditioning of grain was done which was at an initial moisture content of 9%. The grains were moistened to target moisture contents of 9.5 and 10.1% by adding calculated quantity of water. The amount of water needed to reach target moisture content was calculated using the following equation:

$$\boldsymbol{Wa} = \frac{\boldsymbol{Ms}\,(\boldsymbol{Mct} - \boldsymbol{Mci})}{(\mathbf{1} - \boldsymbol{Mct})}$$

Wa = Water needed to reach the target moisture content, (g)

Ms = Mass of sample, (g)

Mct = Target sample moisture content in decimal form

Mci = Initial moisture content in decimal form

Before dehusking, the grain was kept for an hour in a shade to bring to room condition and then fed to the equipment. The initial weight of all the experimental samples for carrying out milling studies was kept constant at 1 kg in case of burr mill, Victor millet mill model-I and Victor millet model-II and 250 g for rubber roll sheller. The kodo millet was dehulled and rice was obtained under 2 passes. The output was a mixture of brokens, husk, head rice and unhulled grains which were then separated manually using IS:12 and IS:14 sieves and weighed.The following observations were recorded and converted into percentages.

1. Weight of the grain fed into machine (kg)
2. Weight of the milled grains (head grain and broken) (kg)

3. Weight of the head grains (kg)
4. Weight of the broken (kg)

The following equations will be used for calculating various dehulling parameters.

$$\text{Dehusking efficiency, \%} = \frac{\text{Weight of milled grain (g)}}{\text{Weight of grain fed to machine(g)}} \times 100$$

$$\text{Head grain yield, \%} = \frac{\text{Weight of head grain (g)}}{\text{Weight of milled grain(g)}} \times 100$$

$$\text{Brokens, \%} = \frac{\text{Weight of brokens (g)}}{\text{Weight of milled grain (g)}} \times 100$$

$$\text{Milling recovery, \%} = \frac{\text{Dehusking efficiency} \times \text{Head rice yield (g)}}{100}$$

Results and Discussion

Results of dehulling trails of kodo millet grain at different moisture levels in various millet dehulling equipment are presented in the Fig. 1 through 4.

Dehulling efficiency: From Fig. 1, it was observed that the dehulling efficiency of Victor millet mill model – II was highest (82.46 – 85.60%) among the four equipment tested for dehulling kodo millet. In all the equipment, better dehulling efficiencies were recorded at lower grain moisture content of 9%. Both the type of machine and initial grain moisture content of kodo millet grains had significant effect on the dehilling efficiency. The effect of grain moisture on dehulling efficiency was reported by many workers (Van Ruiten, 1979; Afzalinia *et al*., 2002). At lower moisture levels, the husk become brittle and could be dislodged relatively more easily than from wet grain. The variation in dehulling efficiency of tested equipment was understandable since, the hulling mechanisms as well as operational parameters in each machine were different.

Milling recovery*:* The milling recovery in various millet dehulling equipment for kodo millet at different initial moisture levels is given in the Fig.2. The milling recovery was found to be 51.28 - 54.43% in Burr mill, 52.77 – 54.39% in Victor millet mill model – I, 57.05 – 57.71% in Victor millet mill model - II and 52.90 to 56.09% in rubber roll sheller. The data showed that the milling recovery in Victor millet mill model - II was better compared to other tested equipment. Within the tested levels, the initial moisture content of grains did not play any significant roll on milling recovery in this machine. However, at lower grain moisture level of 9%, a normal trend reported by other workers (Mechami *et al.,* 1961; Raghavendra Rao and Juliano, 1970). Poor milling recovery from Burr mill indicated its unsuitability

for dehulling kodo millet. Therefore, it could be concluded that Victor millet mill model –II is better for dehulling kodo millet.

Head rice yield: The head rice yield of various millet dehulling equipment for kodo millet at different initial moisture levels is given in the Fig. 3. The head rice yield was found to be 82.96 - 87.69% in Burr mill, 82.96 - 91.86% in Victor millet mill model – I, 87.62 - 89.46% in Victor millet mill model – II and 93.61 to 97.92% in rubber roll sheller. The data showed that the head yield in rubber roller sheller was much better than other tested equipment at all initial grain moisture contents. This might be due to lower pressure exerted on the grains by the rubber rolls during hulling in the rubber roller sheller as reported by many workers (Mechani *et al*., 1961; Battacharya, 1969).

Broken rice (%): The broken rice (%) of various millet dehulling equipment for kodo millet at different initial moisture levels is given in the Fig.4. The broken rice percentage was found to be 12.31 - 17.00% in burr mill, 08.13 - 11.24% in Victor millet mill model – I, 10.52 - 12.37% in Victor millet mill model – II and 2.07 to 06.38% in rubber roll sheller. It could be seen that the broken rice percentage in rubber roller sheller was much lower when compared to other tested equipment. As stated earlier, this might be due to lesser hulling force applied on the kodo millet during dehulling in rubber roller sheller.

Conclusion

Among the four different dehulling equipment's namely, burr mill, Victor millet mill model-I, Victor millet mill model-II and rubber roll sheller that were tested for hulling kodo millet, the Victor millet mill model -II was found to be best based on dehusking efficiency, milling recovery, head rice yield and broken yield.

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Plate 1: Burr Mill

Plate 2: Rubber Roll Sheller

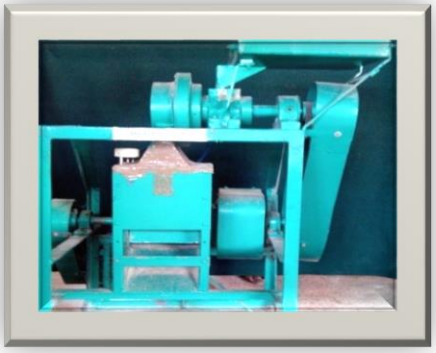

Plate 3: Victor Millet Mill Model- I

Plate 4: Victor Millet Mill Model- I

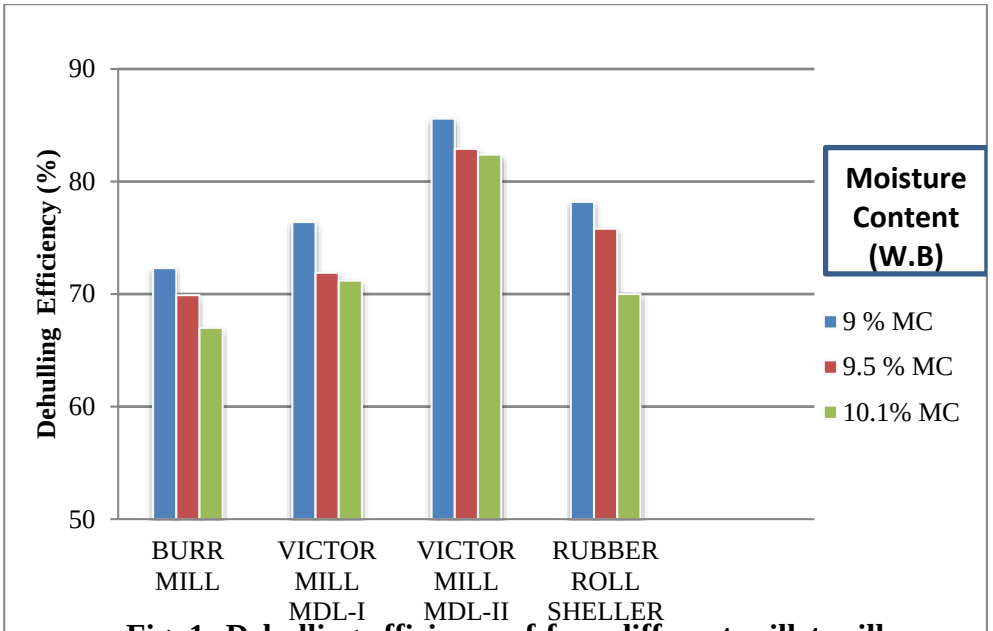

Fig. 1: Dehulling efficiency of four different millet mills for kodo millet at different moisture levels

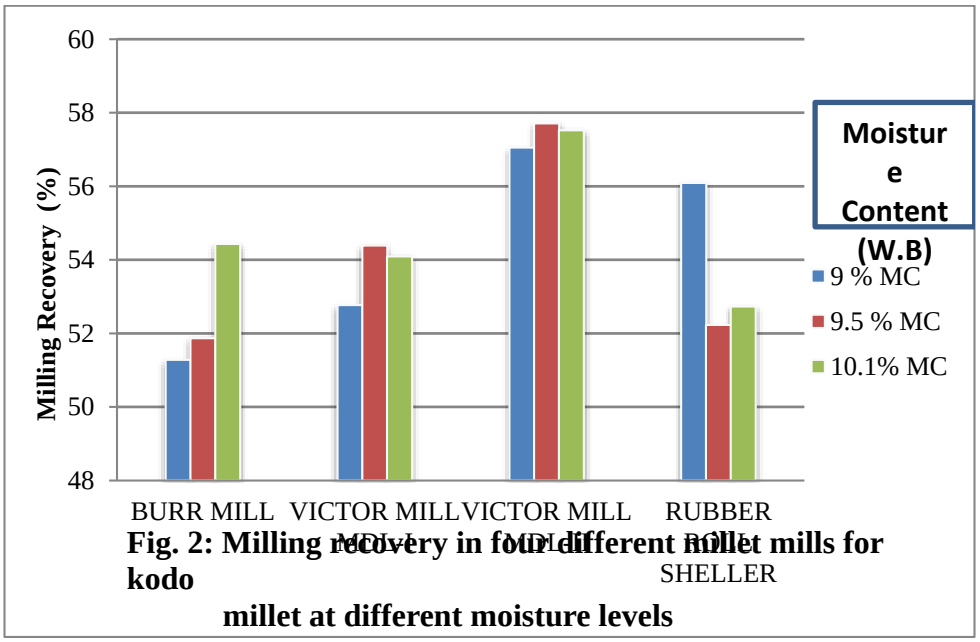

Fig. 2: Milling recovery in four different millet mills for kodo millet at different moisture levels

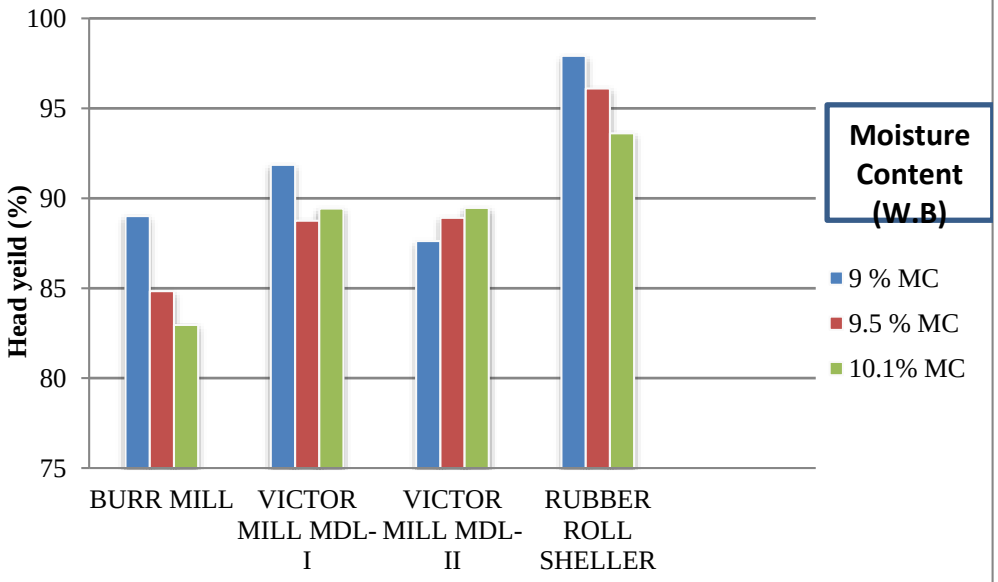

Fig. 3: Head yeild in four different millet mills for kodo millet at different moisture levels

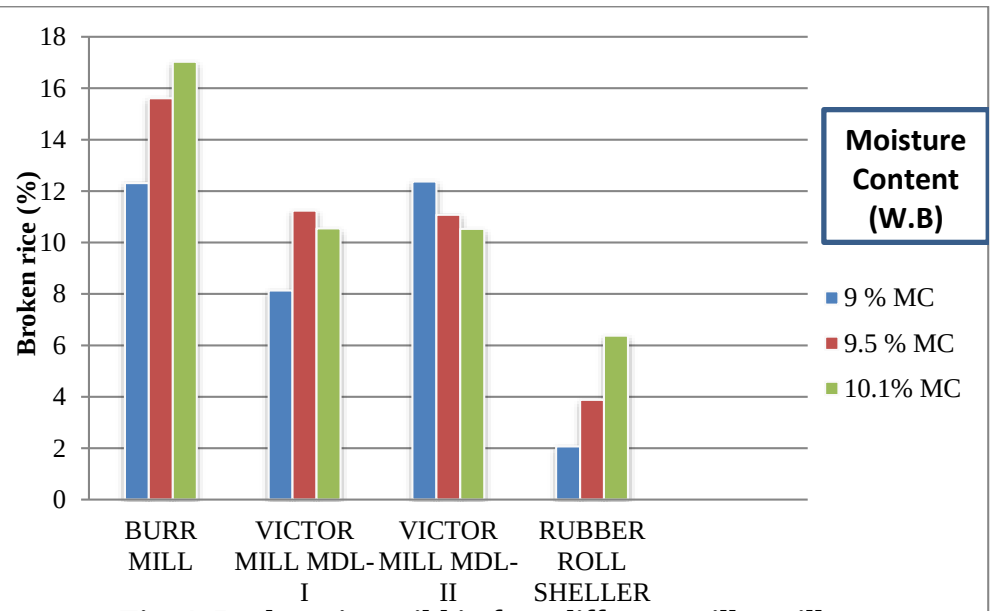

Fig. 4: Broken rice yeild in four different millet mills for kodo millet at different moisture levels

National Seminar on "Emerging trends in processing and value addition of small millets"

S2-OP3 EXPERIMENTING WITH OTAKE HULLER FOR PROCESSING OF SMALL MILLETS- LEARNING & INSIGHT FOR IMPROVING HULLING EQUIPMENT FOR SMALL MILLETS

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The purpose of this experimentation is to find out if the Japanese Paddy Huller can be used to hull Small Millets and to learn from the design parameters to help the fabricators improve their indigenous machineries. Experiments were conducted with five small millets viz.-barnyard, kodo, little, proso & foxtail millets to find out the hulling efficiency, capacity and whole rice, broken rice & unhulled grain percentage. The design parameters studied were: dimensions, weight & portability, safety features, power transmission & consumption, hopper control parameters, hulling impact surface, hulling process, dismantling & cleaning the machine and aspirator air flow control. The anticipated result of this experiment is to find out if it can be improvised to hull small millets and also how such a small and compact machine is able to have higher capacity of hulling than bulky indigenous machines. The findings of this experiment may be compared with the existing indigenous machinery and better features of this machine can be incorporated in their machines by the fabricators of indigenous machineries thus improving their performance.

National Seminar on "Emerging trends in processing and value addition of small millets"

S2-OP4 ADVANCEMENTS IN MINOR MILLET PROCESSING TECHNOLOGIES

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The food processing industries involved in millet processing are on a rise owing to the importance being gained by the commodity. Common barriers in making millets more available to masses have always been with respect to the post harvest technologies viz. pre-cleaning and dehulling technologies and following good manufacturing practices. A deeper understanding on the overall process shows us the gap to be addressed in terms of using food grade materials for manufacturing of processing machines as suggested in the UNFAO and WHO, making the machines more versatile to suit processing of various millets and process efficient in terms of electricity consumption and processing capacity. In addition to the aforementioned points, various other issues with respect to compactness, ease of installation and maintenance were also taken as core concepts in the research towards bringing out effective post harvest technologies.

A detailed analysis on the specific issues/gaps observed in the existing technologies that were addressed through respective innovations leading to the research was presented as the advancements made in minor millets processing technologies by Borne Technologies Private Limited.

National Seminar on "Emerging trends in processing and value addition of small millets"

IMPROVEMENTS IN SMALL MILLET HULLING EQUIPMENTS

S2-OP5

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Victor Agro Sales Company is one of the pioneers in fabricating Small Millet processing machines with around 10 years experience in it. The company has been making continuous improvements in the machines based on feedback from customers and evaluation of machines by DHAN Foundation, Earth 360, TNAU and consultants. Now the company manufactures a range of hulling machines from 30kg/hr to 1 ton/hr capacity and the machines have been given all over India. Due to improvements, the company has been able to cut cost as well as make the machines customer friendly. Now, the company has made single machine which can hull all type of small millets. The company's aim is to produce low cost, maintenance free and efficient Small Millet processing machines.

S2-OP6

MACHINERY USED IN PRIMARY AND SECONDARY PROCESSING OF SMALL MILLETS

Sowmiya T. S.

Executive HR & Marketing

Perfura™ Technologies (India) Private Limited

"Millets are a group of highly variable small seeded grasses widely grown around the world as grains for fodder and human consumptions**.** Processing of small millets is the essential for human consumption. Primary processing of millets is a vital step for obtaining grain rice and for further processing of grains for consumption. They are then ground up to either flour or into grits making them ready for cooking. There are six commonly cultivated millets foxtail, little, kodo, proso, banyard and brown stop. That have a hard cellulosic husk layer that humans cannot digest. The removal of the husk layer thus becomes the primary task of processing of grains. Initially need to remove stone, dust, sticks particles from the grains and continuous process of grading the grains. Primary processing in millet processing is cleaning, grading, dehulling and polishing. Secondary processing is flour making, shifting, roasting, and make value added products. Most of the industries are interested in making value added products like cookies, beverages, breads and etc.,

Technology used for converting the grain into edible form and thereby enhancing its quality is known as processing. Processing of cereals and millets plays significant role during its utilization as food. Minor millets can be consumed by processing them into rice, flour, sprouting, roasted, popped, salted ready-to-eat grains, porridges and fermented products. As millet grains are hard seed coat grains, their processing starts with the task of removal of husk. Primary processing technologies to prepare ready-to-use or ready-to-cook (RTC) products and also secondary as well as tertiary processing to prepare ready-to-eat value added products have been the major limiting factors for their diversified food uses and better economic status.

The difficulties in millet grain processing presents a challenge but nutritional as well as health benefits and consumer demand for health foods provide opportunities in processing, development of suitable technology for newer products and process mechanization. Hence there seems to be very great scope for the machineries manufacturing industries to come up with innovative technologies."

S2-PP1

PHYSICO - CHEMICAL AND FUNCTIONAL QUALITIES OF SORGHUM VARIETIES

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Sorghum (*Sorghum bicolor* (L.) Moench), a tropical plant belonging to the family of Poaceae, popularly called as *jowar,* is the "King of millets" and is the fifth in importance among the world's cereals, after wheat, rice, maize and barley. It is a staple food grain in many Indian states. Sorghum has an advantage over corn in drier and hotter climates. Popping is a simplest, inexpensive and quickest traditional method of dry heat application, wherein grains will be exposed to high temperature for short time (HTST). It is a process which not only retains the actual nutritional profile of grains but also markedly enhances its protein digestibility, bio availability of iron and also significantly enhances its dietary fibre content might be due to the development of resistant starch. Popped sorghum offers potential health benefits including reduced risk of heart disease and cancers that are mainly because of high fibre and antioxidant content. Sorghum varieties viz., K12, CO30 and K8 were selected for the study. The physico-chemical and functional properties of grain were analysed. Results showed that physico - chemical characteristics viz., length, breadth, specific gravity, 1000 grain weight and moisture content were 4.0 mm, 3.5 mm, 0.72 g/ml, 40.6 g and 11.48 per cent in K 12, 3.2 mm, 3.1 mm, 0.68 g/ml, 38.9 g and 11.51 per cent in CO 30 and 4.2 mm, 3.7 mm, 0.91 g/ml, 33.8 g and 10.9 per cent in K 8 respectively. The functional characteristics includes hydration capacity, hydration index, popping per cent and popping yield of selected varieties were 29.10 g/1000 seeds, 0.71 per cent, 91 per cent and 87.91 per cent in K 12, 30.08 g/1000 seeds, 0.77 per cent, 85.5 per cent and 54.94 per cent in CO 30 and 33.8 g/1000 seeds, 0.99 per cent, 90 per cent and 62.22 per cent in K 8 respectively. Among the varieties studied K 12 was found to be the best in popping qualities.

Keywords: Sorghum, popping, functional property, hydration capacity, resistant starch

S2-PP2 STANDARDIZATION OF SIEVE SIZE FOR GRADING IN FOXTAIL MILLET

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Seed size is one of the important factors deciding the seed quality. Seeds produced under variable climatic conditions may result in variation in seed size or grade and ultimately affecting germination as well as subsequent plant vigour and seed production. The aim of seed grading is to get maximum seed recovery with better seed quality so that uniform size seed can be obtained which results in optimum plant population and higher yield. Generally, the seeds are being processed by cleaning and grading considerable amount of quality seeds are being lost as undersize due to the use of unsuitable screens. Determination of optimum sieve size and type of screen is one of the criteria in the Indian minimum seed certification standards (IMSCS) for seed grading. The present study was initiated to find out the optimum sieve size for grading foxtail millet seeds. Foxtail millet seeds were graded using various sieve sizes of BSS 12 X 12, BSS 14 X 14 and BSS 16 X 16. The seeds retained and passed over each sieves were collected separately and tested for its physiological quality of seeds. The results revealed that, BSS 14 X 14 sieve size found effective in terms of maximum seed recovery (69.5%), 1000 seed weight (2.5g), germination (74%), root length (10.30cm), shoot length (7.70cm), dry matter production (0.10mg/10 seedlings), and vigour index (1332). It is concluded that, Foxtail millet seeds could be size graded using BSS 14 X 14 sieve for getting good quality seeds.

S2-PP3

EFFECTS OF PROCESSING TECHNOLOGIES ON THE NUTRITIONAL QUALITY OF MILLET GRAINS

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The millet grains are processed mainly to improve their cooking properties and palatability. Simultaneously, it aids in physicochemical accessibility of micro nutrients, reduces antinutritional factors and increases the bioavailability. Some of the technologies which are commonly used in household and processing industries are decortication, soaking, fermentation, and germination. Decortication was found to have no effect on the protein and fat content of millets; however, it significantly decreased the content of, dietary fiber, minerals, total phenols content and antioxidant capacity. Germination improves the protein digestibility by reducing the antinutrients such as phytic acid, tannins and polyphenols, which are known to interact with proteins to form complexes. It has been found that germination of millet grains increases the free amino acids and total sugars and decreases the dry weight and starch content. Fat content is reduced during germination it may due to loss of low molecular weight nitrogenous compounds during soaking and rinsing of the millet grains and hydrolysis of lipid and oxidation of fatty acids during germination. During fermentation, carbohydrate content significantly decreased with a parallel increase in soluble sugars. In addition, amino acid analysis revealed that fermentation significantly decreased glycine, lysine and arginine contents. Popping and flaking expands carbohydrate and energy values of produces and reduces the crude fat and crude fiber contents. Cooking improves the digestion and absorption of iron upon heat processing by softening the food matrix, releasing of protein bound iron facilitate absorption. Increase in Gamma-Amino Butyric Acid (GABA) content in little millet during soaking and germination may be due to the enzymatic conversion of glutamate to GABA by α-glutamate decaroboxylase. Synthesis of GABA during germination may have triggered due to the limited availability of oxygen during soaking of the seeds. Thus, it clearly shows that food processing strategies are used for improving the nutritional quality to promote millet utilization for future prospective.

Keywords: Processing methods, nutrient composition and anti nutritional factors

S2-PP4 RHEOLOGICAL PROPERTIES OF BARNYARD MILLET FLOUR (CO_1 and CO_2) *(ECHINOCHLOA FRUMENTACAEA)* AND REFINED WHEAT FLOUR BLENDS

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Barnyard millet (Echinochloa frumentacaea) is one of the hardiest millet, which is called by several names viz., kuthiraivali (T), shama (H), shamula (M), sawank (T), sawank (B) and sama (G). The rheological characteristic of raw and parboiled milled barnyard millet flour, refined wheat flour (Control T_0) and its blends in the ratio of 90:10, 80:20 and 70:30 corresponding to T_1, T_2 and T_3, treatments were determined by Chopin Alveograph. The tenacity (P) and extensibility (L) was decreased in all the barnyard millet flour incorporated dough when compared to control (104 mm and 98 mm). The curve configuration ratio (P/L) showed the balance between tenacity and extensibility. The P/L ratio of all the treatments was in the range of 1.2 to 1.5. The maximum P/L ratio was obtained in parboiled milled barnyard millet flour (CO_2) T_3 (1.584) and the dough prepared from this blend did not have optimal viscoelastic behaviour because of the higher P/L ratio. The index of swelling (G) blends showed decreased trends when compared to control (17.20). The baking strength of treated samples (W) of T_1 (177), T_2 (171) and T_3 (170) in raw milled barnyard millet flour (CO_1), T_1 (237), T_2 (220) and T_3 (202) in parboiled milled barnyard millet flour (CO_1), T_1 (195), T_2 (188) and T_3 (180) in raw milled barnyard millet flour (CO_2) and T_1 (241), T_2 (230) and T_3 (207) in parboiled milled barnyard millet (CO_2) samples were lower compared to the control T_0 (297). The baking strength of the raw and milled barnyard millet flour incorporated flour blends was higher than 200 104J revealing the suitability of barnyard millet flour in bread formulation.

Key words: Rheology, tenacity, alveograph, parboiled, barnyard rice

S2-PP5 EFFECT OF STORAGE ON MOISTURE UPTAKE OF BARNYARD MILLET *(ECHINOCHLOA FRUMENTACAEA)* GRAIN AND FLOUR

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Storage quality of grains is an important criterion of consideration to assess their utilization potential. The storage quality of barnyard millet grains and flour (non-roasted and roasted forms) was assessed in terms of moisture uptake at ambient temperature. The moisture content of the non-roasted grain samples stored at ambient temperature increased significantly from an initial of 8.66 to 12.65 per cent at the end of storage period, with a mean uptake of 11.07 per cent. Similarly, the initial moisture content of roasted grain was 5.56 per cent which was lower than the non-roasted sample (8.66%), increased to 7.99 per cent at the end of storage period. The mean moisture uptake of the non-roasted grains (11.07%) was significantly higher ($p<0.01$) than that of the roasted sample (6.65%). The barnyard millet flour also revealed that the similar increasing trend in the moisture uptake in both non-roasted and roasted forms. The initial moisture content of the non-roasted flour was 8.82 per cent which increased to 13.86 per cent at the end of six months, with a mean uptake of 12.01 per cent. The moisture uptake of the roasted flour increased from an initial of 5.80 to 9.04 per cent at the end of storage period, with a mean uptake 7.62 per cent. However, the initial moisture content of roasted flour (5.80%) was lower than that of non-roasted flour (8.82%). The mean moisture uptake of non-roasted flour (12.01%) and roasted flour (7.62%) differed significantly ($p<0.05$). Roasting and storage increased the shelf life of the flour.

Keywords: Barnyard millet, moisture uptake, roasted flour, non roasted flour

S2-PP6

EFFECT OF THRESHING METHODS ON SEED QUALITY IN PROSO MILLET (*Panicummiliaceaum L.)* cv. CO(PV) 5

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Minor millets are considered as 'Foods of Future' for better health and food security and are low water consuming crops. Proso millet is important minor millet grown in India. The crop is able to evade drought by its quick maturity, offer better prospects for intensive cultivation in dry land areas. One of the reasons for low quality seed is due to poor postharvest handling and processing of seeds. Farmers are also lacking in sufficient knowledge on processing viz., threshing, drying, cleaning and storing. All these factors affect the quality of seeds and also method of threshing influence seed quality in terms of germination and vigour. Present investigation was undertaken to find out the effect of different threshing methods on seed quality of Proso millet. Proso millet panicles were harvested manually and dried to 20% moisture content. The dried panicles of 100 kg each were subjected to different threshing methods *viz*., T_1: beating with pliable stick, T_2: threshing with tractor treading, T_3:threshing with paddy thresher. The results revealed that threshing with paddy thresher recorded better values in terms of germination (90%),root length (11.1cm), shoot length (9.8cm), dry matter production (0.06 g/10 seedlings), vigour index-1 (1881) &vigour index-2 (5.40) and time taken for threshing (15 min). The mechanical damage to seeds was higher (17%) in case of tractor treading followed by paddy thresher (9%). It could be concluded that mechanical threshing with paddy thresher is the best method for Proso millet and it is most efficient and economical for threshing of large seed lot.

S2-PP7 CHARACTERISATION OF PEARL MILLET STARCH

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Pearl millet *(Pennisetum glaucum)* is the fourth important staple food crop (next to rice, wheat and sorghum) in India. Nutritionally superior to rice and wheat, the millet grain is processed and consumed in various forms. Pearl millet starch was isolated by three methods with sodium azide, sodium metabisulphite and mercuric chloride. The yield of starch was 48, 40, 45 per cent. Starches were characterized in terms of moisture, crude protein, crude fat, swelling power, solubility, water binding capacity and pasting properties. A significant difference was observed in these properties. The isolated starch from pearl millet may be used as a low cost nutritional ingredient in infant foods and as functional food products such as beverages, custard and soup mixes etc.

Keywords: Pearl millet, Isolation of starch, Gluten free, Physical properties, Low cost

S2-PP8

EFFECT OF THRESHING METHODS ON SEED QUALITY IN FOXTAIL MILLET

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Seed processing is a fundamental component in any planned seed production programme, which aims at improving the seed characteristics. An efficient seed production system should be developed to provide the required quantity of seeds at reasonable cost that will involve all aspects of production, harvest, postharvest operation processing and testing. This post harvest processing could be done through traditional method (manual) or modern (mechanical) method. However, manual system of threshing fails to cope up with this growing demand of cereal and labour intensive. The present studies were carried out three types of threshing methods manual, tractor and mechanical threshing. The mechanical threshing has effective in terms of time taken (5min), total quantity of ear head (100kg), seed recovery (69.2%), germination (73%), root length (10.10cm), shoot length (7.35cm), vigour index (1197) compared to manual threshing and tractor threshing. Hand threshing may not be economical since it is laborious, more time consuming and low in threshing efficiency. It could be concluded that mechanical threshing is a feasible method to obtain good quality seeds with maximum threshing efficiency for large scale seed production of foxtail millet.

S2-PP9

SEED QUALITY IMPROVEMENT IN KODO MILLET THROUGH SPECIFIC GRAVITY SEPARATION

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Good quality seeds can be obtained consistently with efficient use of processing machines, irrespective of seed quality of a harvested seed. Several seed-processing equipments are available to improve the quality of the seed-lot but the efficiency of these machines has not been exploited fully. In many of the seed processing plants, an air-screen cleaner is operated owing to lack of information on other equipment as to how and to what extent seed quality can be upgraded using such equipment. Specific gravity separator is one such equipment which separates seeds based on their density. Its potential has not been fully exploited in seed processing. Hence, a study has been taken up to assess the feasibility of using specific gravity separator in kodo millet for separating chaffy seeds from good seeds. Seeds are separated by two grades grade I and grade II. The grade I separated seeds has effective in terms of seed recovery (82.1%), 1000 seed weight (5.8g), speed of germination (9.0), germination (96%), root length (10.57cm), shoot length (12.28cm), dry matter production (0.039g/10 seedlings) and vigour index (2194) compared to grade II. Higher germination percent in seeds due to well developed embryo and good filling of seeds and the effective utilization of large food reserves for production of energy was expressed through seedling vigour. It is concluded that, seed quality in kodo millet can be improved markedly by subjecting seeds to specific gravity separation and also upgrading the physical and physiological seed quality.

Technical Session 3

Value Added Small Millet Products

S3-L MILLETS: PRESENT AND FUTURE PERSPECTIVES

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Millets are small seeded cereal grains, which are gaining prominence due to their nutritional significance. There are mainly seven millets namely, pearl millet or bajra (*sajje* or *cambu*or *bajri*), finger millet or ragi (*nachni* or *korakkan*), foxtail millet or navane (*thenai*), little millet or samai (*sava*), proso millet or baragu (*vari* or *panivaragu*), kodo millet or haraka (*harik*) and barnyard millet or *sanwa* (*shamul*). Excluding pearl millet, the rest six grains are generally called as small millets. It is well known that, the small millets play an important role in nutrition and diet because of the inherited health benefits associated with them. Foxtail and proso millets contain proteins slightly higher (12.5 g/100g) than wheat, while little millet is a very good source of iron (9.5 mg/100g) and finger millet is known for its calcium (350 mg/100g) contents. Millets score high in their nutritional profile compared to milled rice and other major cereals. Moreover, the carbohydrates present in millets are unique because of the starch granules are compactly arranged and surrounded by cell wall materials which contribute for the dietary fiber component of the grain. Thus, millets do provide a good amount of the dietary fiber to the consumer. Apart from this, each millet possess unique features in terms of nutritional benefits. Finger millet contains good amount of sulphur amino acids like tryptophan, cystine and methionine and also it is a rich source of polyphenols. Due to the presence of polyphenols, finger millet exhibit good antioxidant activity, shows hypoglycemic, hypocholesterolemic and anti-ulcerative properties thus providing the health benefits to the consumer. Foxtail millet shows good antioxidant potential because of polyphenols, carotenes and tocopherol contents. Foxtail millet also accumulates gama aminobutyric acid on germination, GABA regulates cardiovascular functions. Little millet also contains good amount of polyphenols and shows highest iron chelating activity. Similar to foxtail millet, proso millet also contains high amount of carotenoids and tocopherols and thus contribute for its antioxidant activity. Kodo millet contains comparatively high lysine content (3.0-3.5g/100g) among all other millets. It also shows highest DPPH quenching activity among milletsand hypoglycemic nature and reduces cholesterol levels. Barnyard millet contains serotonin derivative, which exhibits anti-inflammatory activity. It

also contains luteolinand tricin which belong to flavonoid group and are cancer preventive in nature.

With such a unique and specific nutritional profile, millets still remained unfamiliar to a wide range of population for several years. However, progressive research on nutritional benefits of millets and increased awareness have attracted health conscious segment of the population towards millet based products. Due to several reasons, the inclination of a consumer towards the millets has been increased in recent years. Such an inclination is beneficial in terms of the development of millet economy, increased production, to sustain the competition from major cereals and most importantly to increase the wide spread utilization of the millets. In this direction, the farmers, researchers, technologists, and food industries need to join hands to popularize millet based products and technologies. Existing methodologies and future possibilities in millet processing have been briefly described below;

Processing

All the small millets except for ragi need shelling to remove the outer most husk. Thus shelling the grain becomes the primary need in millet industry. The grain once shelled can be used similar to rice in any of the food formulations. However, the shelled grain contains a bran layer, whose presence, even though improves the nutritional benefit of the grain, hinders the consumer acceptability and also the shelf life. Thus, polishing the grain becomes another essential step. However, care has to be taken that, the grains are polished to a minimum extent, but not to deprive the kernel of its nutrients. Separation of husked and unhusked grains from the lot is one of the major constraints in the millet milling industry. The husk being a nonedible component of the grain needs to be completely removed before consumption. To avoid this problem, a few of the millet millers, polish the grains in multiple stages which invariantly ends up with completely polished grain without the presence of husk, but with an enormous loss in the nutrients of the millet. Parboiling of the millets improves the shelling quality of the millet to a greater extent. However, parboiling changes the color and texture of the millet thus influencing its culinary properties. In terms of shelling properties and also improving the shelf life of the millet grains, parboiling is highly desirable. Parboiled grains also facilitates for the preparation of expanded millet, similar to expanded rice, which is a ready-to-eat product from millets with diversified food uses.

Millets can also be directly popped to convert into a ready-to-eat product. Due to the presence of bran layer, the popped millet is slightly chewy in nature. The popped millet can further be powdered and a part of the bran layer can be sieved off and can be used in different food preparations. Flaking is also one of the convenient

methods to prepare a variety of products from millets. Flaked millet can further be blistered to improve its taste and texture and has potential to be used as breakfast cereals. Ragi, is the only small millet which is commonly used for malting because of the elaboration of the amylase enzyme. Other millets, however, are not very popular in terms of malting because of the rapid spoilage of the malted grains. The flour from the millet either alone or in combination with other major cereals, can be easily processed by drum drying or extrusion cooking to prepare a range of ready-to-eat products. With careful selection of the ingredients, such products can be easily tailor made to prepare functional foods for target population.

Using roller mill to prepare edible flour from millets, without dehusking step, is one of the novel approaches to prepare different fractions from the millets. Roller milling also facilitates preparation of different fractions rich in specific nutrients from the grain. It was also observed that, the flour prepared by this method, contains lower fat and comparatively better nutrients than the flour from the polished grains. Because of the reduction in the total fat content and separation of bran into a different fraction, the shelf life of the flour will be increased. The bran fraction can be utilized in the formulation of different functional foods after suitable pre-processing. The millets can also be processed to prepare semolina using roller mill.

One of the convenient ways to improve the utilization of millets is by preparation of multigrain products. Since, each cereal is specific in terms of its nutritional significance, the consumer invariable benefits from the synergistic effect of the nutrients from multigrain. Composite and re structured products are generally in ready-to-eat form and can be prepared in different shapes, size, flavor or taste. Thus, the scope of millet processing industry is large. Improvements in the milling technique and preparation of attractive, ready-to-eat products may diversify the food uses of the millets.

S3-OP1

DEVELOPMENT OF NUTRIENT ENRICHED BISCUITS BY INCORPORATING SELECTED MILLETS

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Internationally, child health has been approved as the most important indicator for the development of the world. In the developing countries, poor nutrition is predominantly present in children. The reason is consumption of low calories, protein, vitamins and mineral diet, which is mainly related to malnutrition. The prevalence of malnutrition can be reduced by providing healthy foods with the enrichment of nutrients in a form of convenience foods. Based on this view, the study was designed to develop nutrient enriched baby teething biscuits by incorporating little millet, pearl millet, finger millet, kodo millet and foxtail millet flour at the level of 5 to 25 percent respectively with refined wheat flour. The trial was carried out by blending refined wheat flour, millet flour, fruit pulp, vegetable pulp and other flavouring agents. The combinations were: a).carrot, ajwin and little millet, b).beetroot, pepper and pearl millet,c). chocolate, banana and kodo millet d). apple, pumpkin and foxtail millet and e).chocolate, banana and ragi. The developed biscuits were evaluated by analyzing physico-chemical and sensory characteristics. The nutrient content of the standardized biscuits were ranged from energy - 340.74 to 352.14 kcal, carbohydrate- 70.89 to 74.52 g, protein - 7.45 to 8.0g, fat- 8.21 to 16.06g, fibre- 6.72 to 7.52g and calcium-30.96 to 31.50mg per 100 g. The unit cost for the production of baby teething biscuits ranged between Rs.35 and Rs.40 per 100g.

Keywords: Millets, biscuit, malnutrition and child health

S3-OP2

NUTRACEUTICAL DRINK FOR NUTRITIONAL SECURITY

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Finger millet (*Eleusine coracana*) is one of the oldest cereal grains in the Indian sub-continent having high nutraceutical value. Millet's also called 'nutria cereals' are indigenous grains which are used as folk medicine. Millets contains more fibre, minerals and vitamins, which are normally deficient in the Indian diet and has eight times more calcium than other cereals. Ragi grain is an excellent dietary source of iron, methionine and calcium. The functional benefits of ragi increases haemoglobin, promotes weight loss, good amount of calcium, rich in fibre and it also control diabetes, reduces blood pressure, reverts skin aging, improves lactation, lowers the risk of gall stones, geriatric tonic, fights diseases/prevents cancer. In recent years the consumption of finger millet along with other millets has been increased particularly in the urban sector due to awareness about the inherent nutritional and medicinal properties of millets. By keeping this as a base an innovative, nutraceutical of ragi milk has been developed. Ragi milk with different flavours like cardamom, dry ginger, choco essence, in combination with green gram were prepared. Ragi milk with choco essence and green gram with ragi milk were highly accepted. The prepared milk was stored at room as well as refrigeration temperature. At room temperature the storage life was only one day and at refrigeration storage it extends up to 3 days. The Organoleptic and proximate composition were analysed and found that green gram with ragi milk was found to be highly acceptable with increase in protein (9.625g). Ragi milk with choco essence had an iron content of 3.3mg and Fibre 2.93g which will be suitable for the children and green gram with ragi milk can be consumed by all age groups.

S3-OP3 DOUBLING SMALL MILLET FARMERS INCOME THROUGH VALUE ADDITION- AN ONLINE MARKET STUDY IN COIMBATORE CITY

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Small millets are the ideal food group for all the people irrespective of age. Nowadays awareness about the nutritive richness and therapeutic property of small millets, increased the domestic demand for consumption. While from production side, short-duration nature, drought resistance, fodder usage and higher price add up the advantage and encouraged the farmers in growing small millets. In marketing of small millets, each trader in the market play a different marketing strategy. Online marketing is one among such marketing strategy, currently developing at a faster rate in India. In order to showcase the importance of value addition, this study aims at listing out various value added products of small millets and comparing the organic and conventional price of small millets as well as their value added products in online grocery stores operated in Coimbatore city of Tamil Nadu. The study results showed that value addition boost up the price of small millets and hence it was suggested that farmers should come forward in value addition of their produce in order to gain much profit from small millets production.

S3-OP4 DEVELOPMENT AND NUTRITIONAL QUALITIES OF BARNYARD MILLET BASED VERMICELLI INCORPORATED *EKANAYAKAM* ROOT BARKS

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Barnyard millet is minor millet which consists of fair amount of highly digestible protein, coupled with low amount of slowly digestible carbohydrate. It is also rich in dietary fibre, iron, phytochemicals and antioxidants. Due to this, barnyard millet may be considered as a functional food. Functional foods provide an additional physiological benefit beyond their basic nutrition. They are rich in nutrients and helps to prevent type II diabetes, heart disease, reduce total cholesterol, LDL levels and blood pressure. *Ekanayakam* (*Salacia reticulata*) is a medicinal herb, which can be used as a food supplements to treat diabetes and obesity. The present study was conducted to develop barnyard millet vermicelli and *uppuma* incorporated with *Ekanayakam* root barks. Organoleptic evaluation of vermicelli and *uppuma* was conducted by a panel of judges using nine point hedonic scale. Based on sensory evaluation, the vermicelli and *uppuma* prepared with 40% barnyard millet flour, 58% whole wheat flour and 2% *Ekanayakam* root bark powder was highly acceptable with a mean score of 7.75 and 7.73 respectively. The *Ekanayakam* incorporated barnyard millet vermicelli contains moisture (7.78%), protein (8.09g $100g^{-1}$), fat (1.91g $100g^{-1}$), fibre (3.45g $100g^{-1}$), carbohydrate (50.47g $100g^{-1}$) and energy (263.44Kcal $100g^{-1}$). The barnyard millet based *Ekanayakam* vermicelli was rich in calcium content of 67.90 mg $100g^{-1}$, iron content of 13.99 mg $100g^{-1}$, magnesium content of 101.72 mg $100g^{-1}$ and potassium content of 228.76 mg $100g^{-1}$. Development of novel products with barnyard millet may help the consumers to add variety to their diet and improve human health. Hence, there is an ample scope for the development of various designer foods from barnyard millet.

S3-OP5 NUTRITIONAL PROPERTIES OF COMPOSITE FLOURS PREPARED USING MILLETS, PULSES AND PLANTAIN

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Today's food industries focus the two major factors for health and convenience during the development of breakfast food and variety of snack products, because consumers have sparked the development of convenient and nutritious food products. Pasta is one of the easiest and most versatile food products used today. It is made from durum semolina which is hard grain wheat flour that is high in protein that form gluten produces a smooth dough and cream yellow color. Now a day's to improve the nutritional quality of pasta by the addition of other ingredients for the reason that nutritional well-being is a sustainable force for health and development and maximization of human genetic potential. Therefore, for solving the problem of deep-rooted food insecurity and malnutrition, dietary quality should be taken into consideration. As a result millets were found to have high nutritive value and comparable to that of major cereals such as wheat and rice. In addition to whole grain benefits, multigrain blends helps to maximize their nutritional, functional and sensory properties. Millets (barnyard millet, kodo millet and little millet), pulses (peas and lentil) and plantain flours were prepared by standard procedures. Three composite formulae were formulated and it contains durum semolina, millet flour blends (flours of barnyard millet, kodo millet, little millet mixed at 1:1:1 ratios) and pulse flour blends (flours of peas and lentil mixed at 1:1 ratios) mixed at 1:1ratio and plantain flour (*Musa paradisiaca*) at 70:15:15 percent respectively for formula 1, 55:30:15 percent respectively for formula 2 and 40:45:15 percent respectively for formula 3. Durum Semolina (100%) was used as control. Nutritional properties such as moisture (%), Energy (Kcal), carbohydrate (g), protein (g), Fat (g) and Ash (%) of the selected formulae were evaluated by standard procedures. The results showed that the composite flours of moisture content (7.8% to 8.2%), energy (363.3kcal to 365.6kcal), carbohydrate (78.4g to 81.3g), protein (9.4g to 11.7g), fat (0.1g to 0.3g) and ash (0.72% to 1.38%). These findings revealed that composite flour formulae of protein and ash content were higher than control and it's suitable to make pasta. Thus, use of whole-grain and multigrain substitutes for refined wheat flours can be one important aspect of nutritional, "healthy" and safe, high-quality, and shelf-stable food products and promoting utilization of minor-grain foods.

Keywords: Nutritional properties – Millets flour - Composite flour - Pasta products

S3-PP1

STANDARDISATION AND EVALUATION OF SMALL MILLET BASED DRUMSTICK LEAVES CHAPPATHI MIX

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Millets are nutritionally rich and occupy an important place in the diet of people in many regions of the world. Although millets are nutritionally superior to cereals their utilization as a food is still mostly confined to the traditional consumers and population of lower economic strata. Millets have received attention for their potential role as functional foods due to health promotive phytochemicals. Beneficial uses of millets and health consciousness of the consumer have made food scientists to develop various millet based food products. One possible way of extending their utilization could be by blending them with wheat flour by appropriate processing. In the present study attempts have been made to develop millet based drumstick leaves chappathi mix. In order to prepare multi millet chappthi mix, flours of foxtail millet, kodo millet, little millet and barnyard millet were mixed with wheat flour in different proportions (25:75, 50:50 and 75:25). From the sensory evaluation it was found that fifty per cent incorporation of multi millet flour with wheat flour was highly acceptable. Multi millet based drumstick leaves chappathi mix was standardized by incorporating dried drumstick leaves at different per cent levels (1 to 10 %). Drumstick leaves incorporated chappthi was evaluated for sensory attributes using nine point hedonic scale by a panel of members. Chappathi prepared by incorporating two per cent drumstick leaves scored the maximum. The prepared chappthi mix was analysed for nutrient content using standard procedures. The protein, fat, carbohydrate and crude fibre content of the prepared mix were 10.08g, 2.36g, 64.07g and 4.64g per 100 g respectively. Millet based drumstick leaves chappathi mix also contained 41.76 mg of calcium, 4.21 mg of iron and 125.57µg of beta carotene. Millet based foods can be used to combat health issues.

Keywords: Phytochemical, incorporation, wheat flour, hedonic scale

S3-PP2

EXPLORING THE POTENTIAL OF FOXTAIL MILLET [*Setaria italica (L)*] FOR VALUE ADDITION

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Foxtail millet [*Setaria italica* (L.)] is an important underutilized millet grain, grown in various parts of India. Though the production and availability of millets is low consciousness of consuming millets to fight against lifestyle disorders increased. It has higher protein, crude fibre and fat content and also a good source of dietary fiber and ß carotene. It is rich in B-complex vitamins like thiamine, minerals especially calcium, phosphorous, Iron and certain amino acids like threonine, methionine and low level in phytic acid. Unpolished millets provide more of vitamins and minerals than polished. Several studies revealed that among the minor millets, Foxtail millet has been tried by several workers in the development of various foods which include bread, cakes, traditional foods, weaning foods, popped, extruded, roller-dried, flaked products and noodles. A study concluded that, foxtail millet could be incorporated up to 50 per cent level in refined wheat flour for bread preparation which showed sensory characteristics similar to that of control breads except the physical properties like hardness increased significantly. An attempt on preparation of extruded snacks from foxtail millet based composite flours indicated that composite flour (Foxtail millet; Amaranth; Rice; Bengal gram; Cow pea) could be used to produce quality extrudates with acceptable sensory properties. Another study on the traditional (popping and flaking) as well as contemporary methods (roller drying and extrusion cooking) of cereal processing found that the degree of starch gelatinization was highest in roller-dried samples compared to other millet products. Ready-to-use and ready-to-eat products will enhance the scope for diversified food and allied uses of the foxtail millet and may improve its socio-economic status. The benefit cost ratios of value added products were more as compared to raw foxtail millet. Hence it is necessary to disseminate the technology in making value added products to the producers, industrialists, entrepreneurs to improve the availability of foxtail millet value added products.

Keywords: Foxtail millet, Underutilized millet grain.

S3-PP3

POPPING - A NOVEL TECHNIQUE FOR DEVELOPMENT OF FUNCTIONAL FOODS

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Sorghum is an important staple food in semi-arid regions worldwide. It is considered to be native to tropical Africa and continues to be a leading cereal grain in most areas of the continent. The colour of sorghum grain may be white, yellow, red or brown. A number of processing techniques are used in the preparation of ready-to-eat cereals including puffing, flaking and extrusion of wheat, corn and rice but none for sorghum. Popping of sorghum is a cost effective process to obtain flour with improved starch characteristics and represents an unexploited opportunity to design novel and healthier cereal based food products. There are different methods of popping *viz.,* conventional method of dry heat, sand and salt roasting, hot air popping, gun puffing through sudden pressure differential, popping by hot oil and microwave heating. Popped sorghum is one of the ready - to - eat snacks which is popularly consumed by local growers. Popped sorghum is produced by dry heat application, wherein grains are exposed to High Temperature for Short Time (HTST). Popping of grain occurs when super heated vapour produced inside the grain by instantaneous heating, cooks the grain and expands the starchy endosperm. Popping being a dry heat process may inactivate the lipase and improves the shelf life of popped products. Popping also improves the digestibility of starch as it involves gelatinization of starch and degradation of dietary fibres. Structural changes took place in sorghum starch when popped and the process of popping changed the starch granules into thin lattices of inter-connecting sheets. Whereas, protein bodies remained intact but protein surrounding individual starch granule disrupted. Popped sorghum being a pre-cooked ready - to - eat material can be used in snack foods, specialty foods as a base for development of supplementary foods. Processing of grains to develop products results in improving nutritional profile through inactivation of certain antinutrients and undesirable microorganisms. Popping imparts acceptable taste and desirable aroma to the popped sorghum.

Keywords: Ready to eat cereal, popping, dry heat, gelatinization, gun puffing

S3-PP4

DEVELOPMENT OF MULTIMILLET VEGETABLE ROTI MIX

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Millet grains are nutritionally comparable and even superior to major cereals with respect to protein, energy, vitamins, and minerals. These are also rich sources of phytochemicals and micronutrients. Although millets are nutritionally superior to cereals, their utilization is not wide spread. Hence attempts have been made to develop Multi millet vegetable roti mix by using multi-grain flour. Flours of foxtail millet, kodo millet, little millet and barnyard millet were incorporated with rice flour in different proportions mixed (10 to 100 per cent) to standardize roti mix. While preparing vegetable roti mix, other ingredients like onion, beans, carrot, green chilli, curry leaves, asafoetida and cumin seeds were also added to the mix. Dehydrated vegetables were used for the same. Vegetable roti prepared by incorporating 70 per cent multi millet flour obtained highest acceptability on sensory evaluation. The protein, fat, carbohydrate, crude fibre, calcium, iron and beta carotene content of the developed multi millet vegetable roti mix were 6.13 g, 1.171g, 51.22g, 4.05g, 64.73g, 2.69g, and 262.75g per 100g respectively.

Keywords: Multigrain, dehydrated vegetables, sensory evaluation, multi millet roti

S3-PP5 PREPARATION AND EVALUATION OF TRADITIONAL FERMENTED FOOD *IDLI* FROM SMALL MILLETS

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An attempt has been made to prepare the traditional, fermented, healthy breakfast food *idli* from small millets. Small millets are highly nutritious, non-glutinous and not acid forming foods. They are good sources of protein, micronutrients and functional components like dietary fibre, antioxidants and have been reported for several health benefits such as preventing cancer, cardiovascular diseases, lowering blood pressure, cholesterol and fat absorption, delaying gastric emptying and supplying gastrointestinal bulk. *Idli* is a low calorie nutritious, healthy and easily digestible food which is recommended for all the age groups from childhood to aged people, healthy and sick people. The small millets chosen in the study to evaluate the suitability for *idli* making were kodo millet, proso millet, little millet, barnyard millet, finger millet and foxtail millet. The millet to black gram dhal was standardized with different ratios. *Idli* batter was prepared by traditional household method. The prepared millet *idli* batter were kept under room temperature for natural fermentation, steamed and evaluated the sensory parameters such as colour, flavor, firmness, taste and overall acceptability using 9 point hedonic scale score card. The result suggests that among the six small millets studied, *idli* prepared with little millet, kodo millet and barnyard millet were found to be acceptable for preparation of *idli*.

S3-PP6

DEVELOPMENT AND EVALUATION OF SMALL MILLET BASED PALAK LEAVES DOSA MIX

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Small millets with rich source of nutrients are widely cultivated in India and are considered as the crops of food and nutrition security owing to its sustainability in adverse agro-climatic conditions. Millets were found to have high nutritional value and comparable to that of major cereals such as wheat and rice. Millets are highly nutritious crop that help to prevent the increasing life style diseases. Millets are accepted as functional food and nutraceuticals because they provide dietary fibres, energy, proteins, minerals, vitamins, vitamins and antioxidants required for human health. In the present study millet based dosa mix was developed from flours of multi millets (Foxtail millet, little millet, kodo millet and barnyard millet) along with black gram dhal flour, fenugreek seed flour and rice flour. For standardising millet based dosa mix, millet flours and rice flour were combined in different ratios (25:75, 50:50, 75:25, 100). The developed mix was highly acceptable at 100 per cent incorporation of millet flour. In order to enrich the therapeutic value of the mix dried palak leaves was added at different levels (1 – 10%) and standardized dosa mix. The developed mix was evaluated for their organoleptic quality using nine point hedonic scale. Among the different levels, two per cent of palak leaves incorporation was found to be highly acceptable. The carbohydrate, protein, fat, crude fibre, calcium, iron, β-carotene content of developed palak leaves dosa mix were 58.59g, 12.70g, 2.67g, 5.67g, 77.39mg, 3.87 mg, 191.97µg per 100 g respectively.

Keywords: Functional food, dosa mix, therapeutic value, nutritional security

S3- PP7 POPPED FINGER MILLET - A READY - TO - EAT NEW GENERATION MILLET PRODUCT FOR LIFE STYLE DISORDERS

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Millets are small grasses family. It is major food sources for millions of people, especially those who live in hot and humid areas of the world. The production level of millets in India is 10,910,000 tonnes. Finger millet (*Eleusine coracana*) is popularly known as ragi in India. It is one of the important small millets cultivated in many South Asian and African countries. In Tamil Nadu, the cultivation area is 1190000 ha and production level is 1941000 tonnes. Millets are nutritionally superior than major cereals with respect to carbohydrate, protein, vitamins, minerals, phytochemicals and high dietary fibers. Among various finger millets processing techniques, popping is found to be the best one for effective and better utilization. Popping is a simultaneous starch gelatinization and expansion process, during which grains are exposed to high temperatures for short time (240 – 270^0 C at 7– 9.7 sec). Under this process, super heated vapour produced inside the grains by instantaneous heating, cooks the grain and expands the endosperm suddenly, breaking out the outer skin. Popped finger millet is considered as ready to eat new generation product. The optimum conditions for better expansion of finger millet is moisture content 40 % and drying time 136 to 150 minutes. Popping enhance nutrition availability and palatability of the finger millet. This process brings about structural changes in starch, high crispiness and other textural attributes and increase protein, carbohydrate, dietary fiber and reduces anti- nutrients like phytates and tannins. Bio-availability of calcium, iron and zinc are increased from40%, 9% and 64% to 55%, 35% and 88 % respectively. Millets control the life style disorders like cholesterol, type 2 diabetes, blood pressure, hypertension, obesity and protect against heart diseases, onset of breast cancer and asthma, reduce the risk of gastric ulcers or colon cancer, prevent constipation, detoxifying the body, optimize kidney, liver and immune system health.

S3-PP8

ACCEPTABILITY OF IRON RICH PEARL MILLET BASED INDIAN FOOD PREPARATIONS

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Millets are oldest agronomic group of grasses. In India, the most widely grown and largest produced pearl millet (*Pennisetum glaucum*), is a nutritious staple food that supplies a major proportion of calories, protein and minerals to populations living in semi-arid tropical regions. Biofortified Pearl millet is a viable diet based approach to address the iron deficiency anaemia, a major public health problem worldwide. The study was undertaken to identify the best acceptable percentage of incorporation of iron rich pearl millet (*Dhanashakti*) in commonly consumed Indian food preparations (*Idli, Onion uthappam, Kozhukattai and Sevai*). Rice was substituted with pearl millet in *Idli* & *Onion uthappam* at 20, 30, 40 and 50%; *Kozhukattai* & *Sevai* were prepared with 90, 80, 70 and 60% pearl millet substitution. The prepared recipes and their control were coded and subjected to sensory evaluation (Colour, Texture, Aroma, Taste and Overall acceptability) on a nine point hedonic scale. The overall acceptability score percentage of *Idli* ranged between 93.8 ($Idli_{control}$) and 80.0 ($Idli_{50percent}$). While $Onion\ uthappam_{20\ percent}$ had an acceptability of 94.2%, its control had only 93.1% acceptability. $Kozhukattai_{20\ percent}$ and $_{50\ percent}$ were 99.1 and 93 % up to the standard. $Sevai_{50\ percent}$ and $Sevai_{control}$ were 85 and 93% acceptable. Twenty percent incorporation was highly acceptable in *Idli* & *Onion uthappam,* but in *Kozhukattai* and *Sevai* even 50 percent substitution did not alter its organoleptic properties. The acceptable level of incorporation varies with respect to recipes prepared. Lower the percentage of incorporation the higher is the acceptability. Pearl millet can be added in everyday food preparations without compromising the sensory qualities.

Keywords: Pearl millet, biofortification, substitution, hedonic scale, incorporation

S3-PP9

QUALITY EVALUATION OF SORGHUM FLOUR INCORPORATED SPAGHETTI

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In India, people who are vegetarian mostly depend on cereals and pulses as their staple foods which serve as a main source of dietary protein and energy. But nowadays coarse grains and millets are gaining popularity amongst those who are accustomed to cereals like wheat and rice because of the presence of soluble and insoluble dietary fibre, beneficial in various degenerative diseases. Supplementing the cereals with millets and pulses, improve the nutritive value of vegetarian diets in terms of proteins and minerals. Keeping this in view, the present investigation was undertaken to evaluate the influence of millet flour blends on physical, nutritional, cooking and organoleptic characteristics of spaghetti prepared from composite flour of sorghum, wheat semolina, rice and green gram flour. Fibre and protein content increased significantly ($p<0.01$) with increase in level of millet flour blend incorporation. Cooking time of developed spaghetti from composite flour (6.4-9.0 min) was significantly ($p<0.01$) lesser than cooking time of control spaghetti (10.3 min). Cooking loss of developed spaghetti was on par with the control spaghetti. Mean overall organoleptic score of developed spaghetti from composite flour was in the range of highly acceptable criteria (8.27-8.60). Thirty percent level of composite flour blend incorporation was found to be acceptable. The cost of production of developed spaghetti from millet flour blend was lesser than the market samples.

S3-PP10

DEVELOPMENT OF TRADITIONAL BASED SWEET RECEIPES FROM LITTLE MILLET

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Little millet (*Panicum sumatrense*) is a native of South Eastern Asia, grown throughout India to a limited extent. It is rich in fat; iron and niacin content and are higher than cereals. Little millet contains amino acids in balance proportions and is rich in methionine, cysteine and lysine. They are especially beneficial to vegetarians who depend on plant food for their protein nourishment. The use of little millet in traditional products would increase their utilization. Halwa and Kesari was prepared using little millet at various proportions Based on the sensory evaluation of the halwa and kesari prepared 100 per cent little millet flour was highly acceptable and the overall acceptability scores obtained for halwa was 8.8 and in keasri was 8.9. The standardized halwa and kesari was evaluated for its nutritional quality. The nutrient content of halwa and kesari were 52.15 g and 65.14 g of carbohydrate, 4.45g and 3.82 g of protein, 36.10g and 14.17 g of fat, 2.41 g and 2.40g of fibre, 3.41 mg and 3.52 mg of iron 13.70 mg and 28.75mg of calcium 111.30 mg and 80.46 mg of phosphorous respectively were observed. These value added products from little millet could compete successfully in the merging markets as functional foods and relevance to health needs of targeted group.

S3-PP11

EVALUATION OF TEXTURAL AND COOKING QUALITIES OF EXTRUDED PRODUCTS FROM MILLETS

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Instant noodles was prepared using little millet, kodo millet and banyard millet. Millets were added in a combination of 30, 40 and 50 % with whole wheat flour. Flour mix was steamed, kneaded and cold extruded. The extruded millet product was steamed and dried at 50^{o}C for 7h.Textural properties viz., hardness, cohesiveness, springiness, gumminess and chewiness of different combination of millet products was analysed using Texture analyser. Cooking characteristics viz., cooking time, water uptake and cooking loss of the extruded products were estimated based on the standard methods. From the textural analysis it was found that increase in millet substitution with whole wheat flour for production of extruded products increases hardness and cohesiveness but reduce springiness. Among the three millets maximum hardness, cohesiveness, springiness, gumminess and chewiness was obtained for banyard millet with 50% substitution. Maximum cooking time, water uptake and cooking loss were noted for banyard millet (50%), kodo millet (50%) and little millet (50%) respectively. In general, cooking loss and cooking time increases with increase in millet substitution.

Technical Session 4

Innovation and Promotion of Small Millet Food Products

S4-OP1 ASSESSMENT OF THE SUITABILITY OF MILLETS FOR BAKERY PRODUCTS

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Coarse cereals provide viable alternatives to diversify sources of health components in foods. Obviously, the benefits are highest in whole grain cereal consumption. Although millets are nutritionally superior to cereals, their utilization in the country is not widespread. They are mostly used in the preparation of traditional dishes. One possible way of extending their utilization could be by blending them with wheat flour after suitable processing. Addition of millet flour to wheat flour or other flours were reported to change beneficially physico-chemical, nutritional and functional characteristics of the blended wheat flour which benefits food processors and nutritionists to formulate commercial products based on wheat and millet blends. With this background the present investigation was taken up. The rheological characteristics such as alveograph of multigrain mixes were analyzed by using alveograph. Alveograph was used to determine the resistance, tenacity, extensibility and baking strength of the flour blends as per the standard method. For the constant hydration, alveograph always use 50 per cent hydration (250 g flour, 125 g of water- salt solution). The tenacity value was found to be higher for T_6 I (86mm) which was closer to the control (92mm) which revealed that MGM and control were on par. The L (extensibility) values of the MGM from T_1 to T_8I were in the range of 80 to 84 mm. The extensibility of the multigrain mixes with and without inulin did not vary to a great extent and the values were found to be closer to that of the control. The P/L ratio was the maximum for the control. It was found that the value for all MGM were lesser than that of the control. The baking strength (W) of T_6I (248cm^2), T_8I (243cm^2) and the T_2 (236cm^2) MGMs were higher among treated mixes and comparable to the control T_0 (260 cm^2). Among the MGM, the inulin incorporated mixes had higher swelling index than the multigrain mixes without inulin. The elasticity of T_6I was 40.2 per cent followed by T_8I, T_7I and T_5I. This research finding proved that millets are most suitable for bakery foods.

Keywords: Wheat flour, millet flour, tenacity, extensibility, alveograph

S4-OP3 PROMOTING SMALL MILLETS CULTIVATION FOR LIVELIHOOD IMPROVEMENT OF PALIYAR TRIBES

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Paliyars are Adivasi Dravidian people living in the western ghats falling in the districts of Madurai, Theni, Dindugul, Tiruppur, Virudhunagar and Tirunelveli. They are traditional nomadic hunter-gatherers, honey hunters and foragers. They live as isolated groups. They used to live in rock crevices and caves. They are short in stature and black in colour, with curly hair, thick lips, broad and flat nose. Tamil is their mother language. They used to collect the medicinal plants from the interior forest. Earlier Paliyars were nomadic and later period of paliyars are semi nomadic and the present Paliyars are settlers. Paliyars settlements were located in remote places which do not have any modern amenities and facilities. Their dependency and gain from agriculture is very meager. This tribe is a vulnerable community which needs better agricultural system for livelihood improvement and nutritional security. Utilization of millets as food is confined to the traditional consumers, particularly the tribal population. Millets are a rich source of protein, vitamin B, and minerals such as magnesium, potassium, zinc, copper, and manganese. They contain significant amounts of phenol, which act as anti-oxidants and as preventive for heart diseases and cancer diseases. It is gluten-free, and with low glycemic index, it is suitable for diabetics. In this concern, millet is rapidly becoming a health food and perfect adaptation to ensure nutritional security in these times of climate distress. The government is also promoting millets under its National Food Security Act as key to combating under-nutrition, particularly in rural areas. In this background, to improve the livelihood of Paliyar tribes living in (i) Vadakaraiparai, Kodaikanal (Dindigul district), Paliyankudi (Theni district) and Ezhumalai (Madurai district) an awareness training programme on "Minor millets importance, health benefits and production techniques" was conducted during February 2017 to March 2017. 50 participants were selected for each training after strict scrutiny. Assembling them for an awareness programme is a very tough task but they came with their families happily including children and dogs. They expressed their difficulty in getting back their lands in forests. The participants were given with the seeds in free of cost

procured under DST scheme. They also dealt about the latest processing machines available for small millets milling versus traditional one. From this programme we could learn that most of the paliyar youngsters are going to neighboring districts/ states in search of job for their livelihood and the available folks are very elder and children only. Miles to go to uplift the livelihoods of Paliyar tribes whose knowledge on medicinal plants is extraordinary and has a rich expertise about herbs.

Keywords: Millets, Paliyars, Tribes, Western Ghats, Livelihood improvement and Nutritional security

S4-OP4

DEVELOPMENT OF FUNCTIONAL PROBIOTIC RAGI PORRIDGE

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Finger millet or Ragi (*Eleusine coracana* L.) is one of the important minor millet which play vital role in the diet of rural people. Ragi porridge or *koozh* is being traditionally prepared by spontaneous or natural fermentation which has got many nutritional and health benefits. Being rich in dietary fiber, protein, fatty acid, minerals especially calcium and phosphorus, finger millet has number of health benefits like prevention of diabetics, weight loss, lowering the cholesterol level, bone health etc. Lactic acid bacteria plays a major role during natural fermentation of ragi porridge which gives the typical flavor and taste to the final product. Recently, probiotic based functional food is the current buzz word around globe. Hence, with this view present research was carried out for preparation of probioticated ragi porridge using selected probiotic cultures viz., *Lactobacillus acidophilus* NCDC 14 and *Lactobacillus casei* NCDC 298. Initially, plain ragi porridge (koozh) was prepared as per the traditional household method for standardization using various fermentation time intervals viz., 4h, 8h, 12h and 16h. Based on 9 point hedonic scale sensory evaluation, maximum score for over acceptability of the product was obtained for 8h fermentation time. After standardization of optimum fermentation time of 8h and 12h, plain and probioticated ragi porridge was prepared. The shelf life of the developed product under refrigerated condition was evaluated for 7 days by estimating chemical, microbial and sensory parameters. The phytic acid got decreased from 110-140 (0 days of storage) to 105 to 135 (7 days of storage). The bioavailability of minerals viz., calcium, iron and zinc were found to be increased. Total bacterial count ranged between 12 to 52 log 10^8 cfu ml^{-1}, whereas yeast and mold, coliform count was absent throughout the storage period.

Keywords: Probiotic, bioavailability, phytic acid

S4-PP1 SUITABILITY OF BROWN RICE WITH MILLETS FOR THE DEVELOPMENT OF BAKERY AND EXTRUDED FOODS

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Feasibility of utilizing the brown rice flour along with millets for the development of bakery and extruded products was studied. The bakery products tried were cookies and bread. For the development of cookies, the functional ingredient *viz*., the whole wheat flour was replaced with brown rice flour (30%) and Kodo millet flour / Little millet (70%) for the development of cookies. The rest of the ingredients such as the fat, sugar, baking powder, corn flour and water were slightly altered and standardized for the preparation of cookies. Similarly for bread the proportion used was brown rice flour (20%) and Kodomillet flour/ Little millet (80%). The developed products were studied for its nutrient content, sensory qualities and shelf life and the data was statistically analysed. The results indicated that the cookies with 30% brown rice flour and kodomillet flour (70%) had the highly acceptable quality attributes. Similarly bread with 20% incorporation of brown rice and 80% Kodomillet flour had the superior nutritional quality in terms of protein, fat, crude fibre and minerals. The sensory qualities of these products were also highly acceptable. Brown rice vermicelli was also developed with the incorporation of brown rice flour from 15 to 50% replacing the functional ingredient finger millet flour. Upon evaluation of the nutritional and sensory quality, the results indicated that 30 per cent incorporation of brown rice for ragi vermicelli yielded a nutirionally and sensorily superior product. The cost of production of brown rice cookies was found to be Rs 16.00 per 200 g and the cost of brown rice vermicelli was found to be Rs. 35.00 per kg.

S4-PP2

DEVELOPEMENT OF FENUGREEK LEAVES INCORPORATED MULTI MILLETS INSTANT RICE MIX

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Millets were one of the important cereals, grow in hot, dry areas and used to be a major food for sources for millions of people. Millets has high protein, crude fiber, calcium and also rich in micronutrients. Despite numerous qualities, utilization of millets as food is confined to the traditional consumers due to the non availability of consumer friendly, ready to eat millet based products. In the present study focused to standardized fenugreek leaves incorporated multi millets instant rice mix. The dried fenugreek leaves was incorporated at different levels (1 to 10 %) with the multi millets *viz.,* foxtail millet, kodo millet, little millet and barnyard millet of equal proportions (25 per cent each) and prepared the instant rice mix with other ingredients. The prepared mix was evaluated for sensory attributes using nine point hedonic scale by a panel of members. The mix prepared by incorporating two per cent fenugreek leaves scored the maximum. The prepared rice mix was analysed for nutrient content using standard procedures. The protein, fat, carbohydrate and crude fibre content of the prepared mix were 6.82g, 7.54g, 54.76g and 4.74g per 100 g respectively. With respect to micro nutrients content, the mix also contained 105.56 mg of calcium, 3.14 mg of iron and 395.02 µg of beta carotene. Thus, the availability of nutritious products in the market enhances the millet consumption.

S4-PP3

DEVELOPMENT AND EVALUATION OF MUSHROOM INCORPORATED LITTLE MILLET COOKIES

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Mushroom is wonderful creations of nature". It is a good source of high quality protein, rich in vitamins, minerals and water content and its nutritional value equal to meat, egg and milk with low calorie and cholesterol free. Food value of mushrooms lies between meat and vegetables. The present study was focus on incorporating dried mushroom powder with little millet in cookies. Cookies were standard with little millet and dried mushroom powder at different levels incorporation. Along with the ingredients in the standard recipe, mushroom powder was incorporated at 5%,6%,7%,8%,9% and 10% and little millet was incorporated at 25%, 50% and 75% respectively. Result of organoleptic evaluation showed that 10 per cent mushroom with 75 per cent little millet was highly acceptable, with score for overall acceptability being 8.5 than the control cookies. Protein, fibre and iron content of the standardized cookies were found to be 9.32g/100g, 2.56g/100g and 2.06 mg/100 respectively than the control cookies. The shelf life of the product was better in plastic containers (600 gauge- P_2) than propylene bags (200gauge-P_1) up to 30 days and the microbial population was within the safer limit during the storage period.

S4-PP4

EFFECT OF ANNEALING AND ULTRA-SONICATION TREATMENTS ON THE PROPERTIES OF FOXTAIL MILLET STARCH

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Foxtail millet (*Setariaitalica* L.) is one of the earliest cultivated crops, extensively grown in the arid and semi-arid regions of Asia and Africa, as well as in some other economically developed countries of the world. Most millet varieties particularly foxtail millet remains under-utilized as a food source. Foxtail millet contains a pertinent amount of nutritional components, especially starch, protein, vitamins, and minerals. Foxtail millet is commonly used as a bird/ animal feed in the prosperous societies, its potential remains unexploited. Further research and development work is inevitable particularly on making the processing techniques for foxtail millet flour and starch to improve the product quality, and the health impact of the products. The literature published gives an inadequate understanding of the properties and potential uses of foxtail millet starch. Hence, in the present study foxtail millet starch was isolated and subjected to dual modification by Annealing and Ultra-sonication and their properties were analyzed. The yield of foxtail millet starch was about 57%. The moisture content of starch was 4.96%. The hunter lab colorimeter results showed *L** value of 87.70%, *a** value of 0.33, *b** value of 9.91% for the native foxtail millet starch. The extracted starch properties has analyzed for its potential uses in food and non-food applications.

Technical Session 5

Marketing Strategies for Small Millet Products

S5-OP1

DISSEMINATION OF MILLET BASED NUTRITIONAL KNOWLEDGE AMONG THE RURAL WOMEN AND THEIR PERCEIVED IMPACT

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The present day lifestyle and changed dietary patterns has led to prevalence of anemia, nutritional deficiency and diabetes. India is the capital for diabetes and 62 million people suffering due to diabetes which is expected to increase to 87 million by 2030 due to the increasing consumption of highly polished rice grains and decreasing consumption of coarse cereals. In recent years, efforts have been made to convert the millet grains into convenient forms such as multi-grain flour, malt and other value added ready to eat products to the consumers through the establishment of enterprises on millet with the help of SHGs in rural areas. Instant millet mixes offer great convenience to the homemakers to prepare traditional delicacies. But, in real sense, women have no proper and sufficient technical knowledge and professional training to set-up a new venture. Keeping this in view a study was conducted in Madurai district to disseminate the millet based knowledge among the 180 rural women for improving their health status through various extension approaches. The knowledge before and after the interventions were assessed. After imparting the nutrition education through various trainings, demonstration and extension approaches the average knowledge gain was 53.37 %. The quantum of improvement on knowledge was 2.1 times. The skill on doing value addition in millet based products has increased to 51.67 percent. The decision making behavior to buy nutritious food has increased (49.16%) due to training programmes. Confidence to take up for millet based entrepreneurship activities and Leadership quality due to group exercises, group meetings, group discussion during trainings, nutrimela ranging from 43.33-45.00 percent. Consultation by fellow women and Group coordination among the members for taking initiatives had also changed ranging from 20-25 percent. The overall perceived socio economic impact on millet based interventions is approximately 40.00 percent. If we motivated the women still we could increase knowledge on health benefits and entrepreneurship skills for the additional income.

S5-OP2 Millet Rice: A few tips to identify quality & to address consumers' cost concerns

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Millets are ancient dry land farmed cereal grains. Commonly available nine different grains in India are considered as millets. Historically millets were the poor family's food and continue to be the default source of nutrition even today in remote, socially and economically challenged communities. Millets are coming back in vogue among better off communities as people have rediscovered how nutritious these grains are. But in the recent past individuals and families have lost the 'common sense' knowledge of how to identify what is good quality and what is not.

Some simple techniques to identify quality of different millet rices and some calculations that would help in addressing cost concerns among the consumers looking to work millets into their diet are shared in this presentation.

S5-OP7 PROMOTION OF SMALL MILLET FOOD BUSINESS

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"Today's consumers' are well aware of the fact that millets have more nutritional value than cereals. Also consuming rice was seen as a status symbol during the past, but as of now even the high class societies have started to consume Kuthiravaali rice. Moreover consumption of millet based cookies have increased among adults and children. As there is a shift in the consumption pattern among the consumers', there seems to be a very good opportunity for millet based businesses and the machinery manufacturing industries to flourish.

The promotion of small millet based food business must start foremost from the SAUs'. Trainings on value added products must be imparted, so that aspiring youth, school dropouts, women and others could gain knowledge on the processing and packaging technology in order to start a business of their own with minimal investment. In this way SHGs' could be encouraged to do businesses based on value added products in millets and supply to the bakery units, restaurants and retail units. On the other hand the retail units and retail outlets can use their own brand/national brand and market to the ultimate consumers.

Moreover millet based business loans with ease of processing must be provided to the community, ie, SHGs', individuals, entrepreneurs who dares to start millet based business. Already much awareness regarding the health benefits of millets and the allied products were created among the consumers. Hence the promotion for boosting the business must start from the SAUs' to impart proper training and guidance along with the aid of banking sector to provide loans to those willing to do innovative millet based businesses. Also subsidies for the machineries for processing millets would also be a great promoter for the businesses to flourish."

S5-PP1

ENHANCING SMALL MILLET PRODUCTS THROUGH MARKET STRATEGY

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A number of different small-grained cereal grasses are collectively described as 'Millets'. Millets are one of the oldest cultivated foods known to humans. Two main groups of millets are major millets (sorghum and pearl millet) and small millets based on the grain size. Small millets are small-seeded grasses that are hardy and grow well in dry zones as rain-fed crops, under marginal conditions of soil fertility and moisture. Small millets are also unique due to their short growing season. They can develop from planted seeds to mature, ready to harvest plants as little as 65 days. This is important in heavily populated areas. When properly stored, whole millets will keep for 2 to 3 years. Small millets are highly nutritious, non-glutinous and not acid forming food. Hence they are soothing and easy to digest. Small millet consumption is currently limited by the multiple constraints which are reinforced by low technology application and poorly developed markets. What is needed is a comprehensive and integrated development strategy aiming at demand stimulation, increasing production, developing local processing infrastructure and local market development on an extensive yet location-sensitive scale. Multi-stakeholder participatory research needed to act as a catalyst for realizing this development strategy. The state needs to create a level playing field for small millets when compared to other food grains and other sectors. Only then it is possible to jump start the small millets economy to a threshold level where the market can play a significant role. While there are some polices for production support and for inclusion of small millets in public food schemes, there are currently no policies for creating local processing infrastructure and for local market development.

Keywords: Small grained cereal, integrated development, multi stakeholder, local market

S5-PP2

STUDY ON IMPACT OF SMALL MILLET PRODUCTS THROUGH NUTRITION EDUCATION

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Small millets are nutricereals which has to be promoted in our regular diet for nutrition and health security. Hence, the Knowledge, Attitude and Practice (KAP) of rural women of Peraiyur Taluk, Madurai, Tamil Nadu, India with respect to consumption patterns of small millets was studied. small millet .Nutrition education programme was aimed to improve the knowledge regarding the nutritional significance of barnyard millet and kodo millet, health benefits of small millets and need for product diversification for a period of six months. The feasibility of using millet based products in daily dietaries and use of millet based instant mixes was also included as a major theme in the nutrition education programme which was implemented in the form of hands on training in the method of millet based preparation of instant mixes. This brought about considerable positive changes in knowledge, attitude and practice among the rural women. Before nutrition education, 53 per cent of the rural women obtained a low score of 0-25 followed by 33 per cent of the rural women having a score of 26-50, only 10 per cent and 7 per cent of the women had scores of 51-75 and 76 - 100 respectively. After nutrition education 72 per cent of the women scored maximum scores 76-100, 23 per cent of the women had knowledge scores ranging from 51-75. Around three and two per cent of the women had obtained scores from 26-50 and 0-25 respectively. These results indicated significant impact of Nutritional Education on the Knowledge, Attitude and Practice of nutritional significance of small millets, usage of small millet based value added products, improved millet consumption pattern and processing of small millet products as a tool for self employment and income generation.