EVALUATION OF SENSORY, PHYSICAL AND PHYSIO-CHEMICAL ANALYSIS OF HIGH FIBRE ROASTED MULTI MIX FORMULATED PASTA

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Abstract
Pasta is now a days being consumed all over the world and it is liked by all age groups. Pasta is usually made of semolina and refined wheat flour which is devoid of fibre. The objective of the study is to formulate high fibre multi mix pasta with the incorporation of millets, whole cereals and pulses combination that increases its nutritional value as well as its fibre content. The three variations of pasta were prepared by roasting the grains and then its sensory evaluation was done. The high score of overall acceptability of pasta were chosen for further study. The mix –I was selected with the high score of (4.40±0.56) compare to mix-II (3.80±0.66) and for mix-III (4.20±0.61). The selected variation of pasta and mix was evaluated for physical and for physio- chemical analysis. Under physical parameter of selected pasta Optimum cooking time, cooked weight and cooking loss was checked. OCT was 369 seconds, cooked weight 140% and cooking loss was 22%. Under physical parameter of selected mix, bulk density, water solubility index, swelling index and anti-nutritional factors (Tannin, Phytate, Saponins, Total Phenolic and Trypsin Inhibitors) were analyzed. The bulk density of selected Mix-I was 0.75g/ml, water solubility index was 4.2%, swelling index was 4.6 %, Tannin 0.39 g/100g, Total phenolic 73.8 mg/g, Phytate 5.41 g/100 g, saponins 11.97 g/100 g and trypsin inhibitors was 491 TI/g. The Physio- chemical nutrient analysis of selected Mix-I was for Ash 2.511g/100g, Moisture was 2.54 g/100 g, Energy 395.39 Kcal, Carbohydrate 77.62 g/100g, Protein 14.20 g/100, fat 3.12 g/100g and fibre was (Crude 0.6, Soluble 4.77, Insoluble 2.79 g/100 g). The conclusion of the study is that the formulated pasta is high in nutritional value with the high content of protein, and fibre.

Keywords: Millets, Pasta, Sensory Evaluation, Physical Parameter, Physio-Chemical Nutrient Analysis, Bulk density, Swelling Index, Water Solubility Index and Anti- Nutritional factors.

Introduction
Pasta is an ancient ready-to-eat food product made up of durum wheat and water using a high-capacity cold extruder with different types of dyes to ensure different shapes of product. Pasta contains carbohydrates, proteins, Vitamin B Complex, and iron and is low in sodium, amino acids and total fat. The content of fat in pasta is unsaturated so; it does not cause any adverse effects on the body. The uncooked pasta contains about 68.2 g starches, 11 g of protein, 4.3 g soluble sugar, 2.8 g fibre and 1.4 g fat which gives 353 kcal **(Giacco *et al.*, 2016).** Pasta is among one of the most favored foods being consumed globally because of its affordable price, low glycemic index, easy cooking and desirable taste. Pasta is usually made from semolina, which is high in calories but poor in dietary fibre, minerals, vitamins, and essential amino acids **(Ghandehari Yazdi *et al.*, 2020).** The processing techniques aims to increase the physicochemical accessibility of micro-nutrients, decrease the content of anti-nutrients and increase the content of compounds that improve bioavailability of nutrients (**Hotz C, 2007).** Food processing is the transformation of raw materials, by physical or chemical means into food, or of food into other forms. It is widely accepted because it is a simple and inexpensive way of traditional processing technique and is an effective method of achieving desirable changes in the composition of millets, pulses and grains. Dietary fibre of wheat may also help people feeling of fullness and therefore help with a healthy weight. Further, wheat is a major source of natural and bio-fortified nutrient supplementation, including dietary fibre, protein and

dietary minerals **(Hefferon K.L, 2015).** Hence, to improve its fibre and nutritional quality and therapeutic value, the cereal whole wheat, yellow maize, millet like barnyard millet, pearl millet and pulses like bengal gram and cowpea is being used and roasting methods of processing are selected for this study to formulate a pasta product.

Objectives of the study

- Formulate a high fibre multi mix pasta with high score of acceptability
- Evaluation of physical and physio- chemical nutrient analysis of selected mix and pasta

Research Methodology

Selection and procurement of raw materials: The raw materials selected for the study are whole wheat, pearl millets, barnyard millets, yellow maize, bengal gram and cowpea.

Whole Wheat (*Triticum aestivum*) provides nearly 55% of carbohydrates and 20% of the food calories. It contains carbohydrates 78.10%, protein 14.70%, fat 2.10%, minerals 2.10%, a considerable amount of vitamins (thiamine and vitamin B) and minerals (iron, zinc). Wheat is also a good source of trace minerals like magnesium, and selenium and nutrients which are essential for good health (**Topping D, 2007).** Yellow Maize (*Zea mays L.)* has suboptimal amounts of the essential amino acids tryptophan and lysine, which accounts for its lower status as a protein source. However, the proteins of beans and legumes complement those of maize. As per United Nation Food and Agriculture Organization, 100 g of maize gives 1698 KJ of energy, 10.4 g of protein, 5.3 g of fat, 82 g of carbohydrate and 8.1 g of fibre **(United Nation Food and Agriculture Organization, 2017).** The Energy content of pearl millet is greater than sorghum and equivalent to brown rice due to its rich unsaturated fatty acids (75 per cent) and linoleic acid (46.3 per cent) contents **(Jaybhaye *et al.*, 2014).**
Barnyard millets *(Echinochloa frumentacaea)* are nutritious millets which are rich in minerals, protein, dietary fibre, resistant starch and antioxidant (**Ugare R, 2011**). Bengal Gram **(***Cicer Arietinum***)** is known for its ability to boost energy in the body and improve digestion. The fibre content in bengal gram helps to improve the digestive system by improving the digestion process and averting constipation. A cup of boiled “kala chana” contains 269 calories. It has 4 g of total fat, which is less than ½ g of cholesterol. Each cup of kala chana provides 13 g of dietary fibre. A high-fibre diet lowers cholesterol levels and helps regulate blood sugar levels in individuals with diabetes **(Natalia Stein, 2018).** The low glycemic index of cowpea is attributed to the action of resistant starch and dietary fibre which attenuate insulin responses and reduce hunger (**Oboh, 2010).**

The above ingredients are selected for product development because they are high in fibre and possess low glycemic index values.

All the ingredients like whole wheat, yellow maize, pearl millet, barnyard millet; bengal gram and cowpea are of grade-1 quality and have been purchased from the markets of Coimbatore (Kalapatti). The grains have been hand sorted to remove all the dirt and foreign materials. Grains were subjected to processing such as sorting, cleaning, and grading before being finally processed using further steps.

Processing of raw materials- Roasting: All raw ingredients were cleaned for residue, stones and other impurities. These were then separately ground to a fine powder in a flour mill (0.1 mm) of size. After that, all flour was separately dried roasted in a pan at a low flame till the flour turned into golden brown in color.

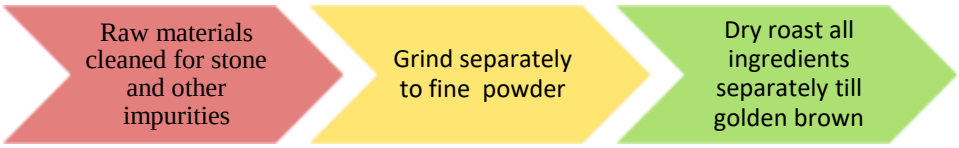
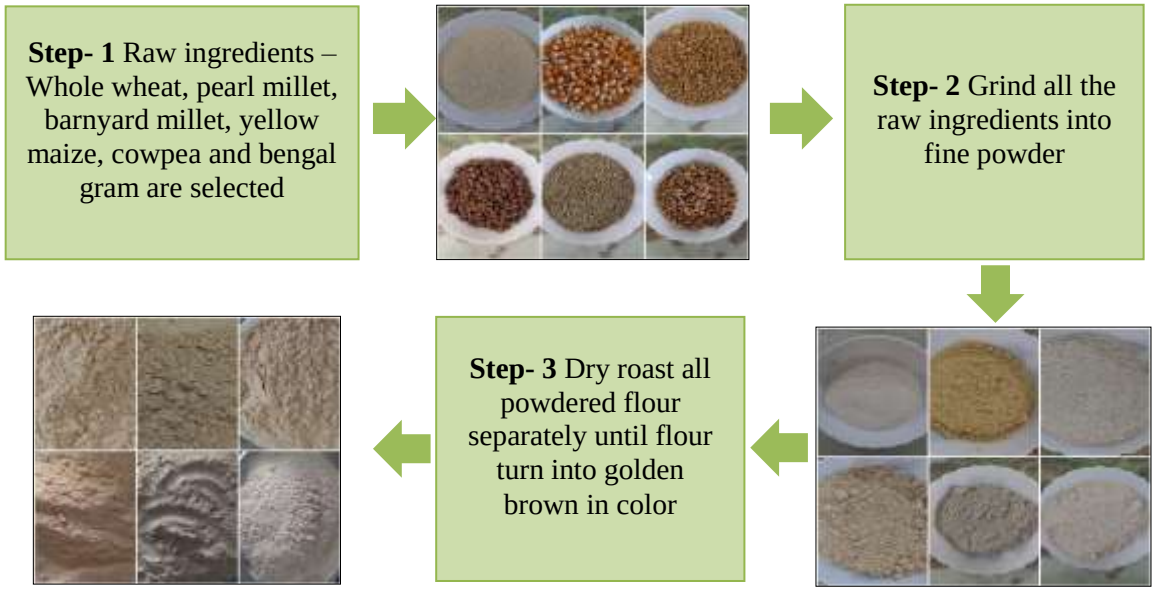


Plate-I

Flow chart of preparation of roasted mix flour



Standardization of Mix

In the present study, the flour is standardized into three variations separately with roasted. In the first variation, Mix –I, the ratio of wheat flour is 50% while other ingredients such as pearl millet flour is 10%, yellow maize flour is 10%, barnyard millet flour is 20%, cowpea flour is 5% and bengal gram flour is 5%. In the second variation, Mix –II, the ratio of whole wheat flour is 50%, pearl millet flour is 10%, barnyard millet flour is 10%, yellow maize flour is 20%, cowpea flour is 5% and bengal gram flour is 5%. In the third variation, Mix –III, the ratio of whole wheat flour is 50%, yellow maize flour is 10%, pearl millet flour is 20%, barnyard millet flour is 10%, cowpea flour is 5% and bengal gram flour is 5%.

Table- I Standardization of roasted mix flour

Ingredients	Mix I (g)	Mix II (g)	Mix III (g)
Whole wheat flour	500	500	500
Yellow maize flour	100	200	100
Pearl Millet	100	100	200
Barnyard millet	200	100	100
Bengal gram flour	50	50	50
Cow pea flour	50	50	50

Preparation of Pasta: The Pasta was prepared as per the six combinations of wheat, pearl millet, barnyard millets, yellow maize, bengal gram and cowpea in prescribed proportions. The weighed quantities of all the ingredients were taken together and then weighed amount of 1 kg of all roasted flour of different variations separately were put into pasta making machine (Model no. Dolly Mini P3). The kneading operation was carried out for 25-30 minutes after adding the appropriate amount of warm water. A 200-220 ml of measured amount of water was slowly added, mixed and kneaded into stiff and homogenous dough. The dough was extruded through the die into a rotini (spiral) shape and cut into 4 cm lengths using a cutter attached to the pasta extruder. Depending on the shape of the end product, the cutter speed was adjusted to the optimal level (3 to 12 rpm). The formulated pasta was collected in a tray and dried at room temperature (25-27 °C) and then sundried for 5-6 days until the final moisture content in the pasta was reduced. Check the dried pasta by pressing it by hand if it is hard and crisp it means it is fully dried. The prepared pasta was then stored under ambient conditions (20-35 ° C) in airtight container at room temperature for further analysis.

Plate-II

Flow Chart of Preparation of Roasted Flour Pasta

Standardization of Mix into 3 variations for each of Roasted flour

- 200-220 ml of water
- Mixed and kneaded for 30 mins
- Pasta cut into rotini (spiral) shape
- Collected pasta at room temperature (27-28 °C)

3 variations Mix-I, Mix-II, Mix-III of Roasted Mix Flour Pasta

Sun-dried for 3-4 days until it's hard and hand crisped

Extruded pasta is stored under ambient conditions (25-35 °C) in airtight container

Organoleptic evaluation of developed product Pasta: Besides any food having high nutritional value, it is important that it must be acceptable to consumer by means of its good appearance, flavor, taste and texture. When a food fulfils all these qualities positively, it becomes the most acceptable food product by consumers.

Cooking of Pasta for organoleptic evaluation: The Pasta was prepared using the following steps: Pasta sample (25 g) was cooked in 250 ml of boiling water until the center core disappeared (checked by pressing by fingers). It took 6-7 minutes to cook the pasta completely. The pasta was subsequently drained using a stainless-steel sieve. Salt was added to the strained pasta. The pasta was then served to the participants for sensory evaluation and scorecard was collected. Finally, overall acceptability is calculated for each product variation.

Hence, the developed pasta of three variations was sensory evaluated by a panel of 30 subjects (male and female with their age between 20-30 yrs.) comprising of semi-trained panelist and faculty of the Department of Food and Nutrition, Dr N.G.P Arts and Science College, Coimbatore for the sensory attributes like appearance, color, texture, flavor and overall acceptability. The Pasta was cooked in 200 ml of boiling water for optimum time with a standardized amount of salt. The panelists were asked to taste the pasta and present their score from 1-5 in the sample (Pasta) for appearance, flavor, taste, texture and overall acceptability by using a scorecard. The best-accepted variations of pasta from roasted mix were analyzed for further tests.

Quality Evaluation of Selected Pasta and Mix

Physical Parameter of Pasta

Cooking quality of the grain is an important criterion to access the consumer acceptability**. (Urbano G, 2005).** Pasta with high cooking quality should be characterized by high water uptake, low mass losses, low adhesiveness, and high hardness (**Bruneel & Delcour, 2010).** The optimal cooking time for fresh pasta was shorter, which may be a result of higher moisture and faster rehydration than dried pasta, where water content was minimized to 120 g/kg. **Park and Baik, 2009** suggested that the OCT depends on various parameters such as amount of protein, quality of gluten, and strength of the flour. However, this result could be related to the interruption of the gluten network by the fibre particles, which provided a path of water penetration into the pasta that decreased cooking time. According to (**Smatanová and Lacko-Bartosová, 2014**), cooking loses of quality pasta should not exceed 8% of the dry weight. Cooking loss is used to evaluate the performance of pasta during cooking, and its value should not be more than 8% (**Teterycz *et al.*, 2020). Laleg *et al*., 2017** suggested the cooking loss increased by reduction of the gluten. In fact, increased amount of fibre in pasta may prevent the gluten matrix expansion. This could lead to an increase in the vulnerability of starch and other ingredients to being solved in boiling water during cooking **(Kaur *et al.*, 2017; Teterycz *et al*., 2020).**

To check the cooking time the pasta from selected roasted mix flour was taken. 25g of selected pasta from roasted was cooked in boiling water and time was noted. The Pasta was cooked completely and checked by pressing by finger until the white core of the pasta completely disappeared. The total cooking times of selected pasta were noted. To calculate the cooked weight, the weighed amounts of selected roasted pasta was taken and cooked with boiling water, then drain the water completely. Once the pasta reaches to the room temperature their cooked weight was measured. To check the cooking loss of selected roasted mix-I flour pasta, 25 g of weighed pasta mix-I were immersed in 180 ml of water and boiled separately. Once the pasta was cooked, the pasta was strained with the help of sieve. The collected water was boiled until the water was completely evaporated in a stove at 105ºC. The residues were collected and dried for 12 – 14 hours and weighed the residue on an analytical balance from the selected mix and it can be determined as a percentage of total weight of pasta before cooking.

Physical Parameter of Mix (Bulk density, Water solubility index, Swelling Index and Anti-nutritional factors were analyzed.

Bulk density is an important parameter that determines the packaging requirement of a product. **(Parde SR, 2003).** The decreased bulk density flour indicates low porosity or air spacing in the flour, therefore less auto oxidation. This is an advantage in respect to spoilage, packing and transportation as goods in relation to weight. **(Merill AY, 1973).**

The bulk density of the composite flour was analyzed according to the method stated by **Oladele and Aina, 2007** in which a mass of 50 g of the sample was put into a 100-ml measuring cylinder. The cylinder was tapped continuously until a constant volume was obtained. The bulk density was then calculated as the weight of the grounded flour (g) divided by its volume (ml).

Bulk density (g / cm^3) = weight of sample / volume of sample after tapping

Solubility is an indicator of the degree of starch granules dispersion after cooking. **(Bhupender SK, 2013)**. The solubility could imply to the amount of amylose leaching out from starch granule when swelling, therefore the higher the solubility, the higher will be the amylose leaching. (**Reungmaneepaitoon S, 2006).** Difference in solubility could also be attributed to different chain length distribution in the starch. (**Bello Perez LA, 2000)**

WAI and WSI are determined in triplicate following the method described by **Carine *et al.*, 2010.** Each sample (1 g) is suspended in 20 ml of distilled water in a tared 50 ml centrifuge tube and stirred with a glass rod, put in a water bath for 30 min at 30 °C temperature. Subsequently, the dispersions are centrifuged at 2000 g for 10 min using a centrifuge (Remi Q-8C, India). The supernatants are poured into dry test tubes and stored overnight at 110 °C for the process of evaporation.

WAI and WSI were calculated using the following equations:

WAI = weight of sediment/weight of dry solids
***WSI* =** (Weight of dissolved solids in supernatant x100)/ Weight of dry solids

Swelling capacity is an important parameter in determining the sample consistency (solid, semi-solid and liquid) and they are dependent on the compositional structure of the sample. **(Omegie HNA, 2013).** The swelling behavior below 16 g/g is considered as highly restricted. This restricted swelling behavior of the flour samples indicates its stability against action when subjected to heat. **(Ugare R, 2018)**.

Anti-nutrients are either synthetic or natural substance and when it is present in foods, they will decrease the bioavailability of the nutrients that are present inside the foods.

Plant foods such as cereals and legumes naturally contain different anti-nutritional compounds. The negative effects of cereal and legume anti-nutritional factors on the bioavailability of essential nutrients and thereby to under-nutrition are well-documented **(Gilani *et al.*, 2012, Clemens, 2014).** Among the anti-nutritional compounds of most significant importance to be mapped in multi-mix flour is phytate (or phytic acid). Phytate is widely present in plant-based foods. It is well-documented that even small amounts of phytate in the diet will significantly reduce iron absorption (**Hurrell, 2004).** The bioavailability of mineral elements for absorption is affected when phytates in grains bind to the minerals and form indigestible complexes **(Dahouenon-Ahoussi *et al.*, 2012**). The problem of high dietary bulk density and anti-nutritional factors could be solved using malting, roasting and sprouting other processes such as extrusion (**Hotz and Gibson, 2007).** Extrusion is a food processing technique with the characteristics of high temperature and short time applied in the development of food products **(Tiwari and Jha, 2017).** Extrusion is a processing technique that has been shown to decrease anti-nutritional factors, improve the digestibility of starch and protein, and increase Iron bioavailability (**Diaz *et al.*, 2013).**

Physio-chemical parameter of selected Mix: The selected roasted mix was tested for energy, carbohydrate, fat, protein, ash, moisture and fibre (crude, soluble and insoluble) by using AOAC method.

Table- III Chemical Quality Analysis of the sample (Method of Analysis)

S. No.	Parameter Analysed	Method of Analysis
1.	Protein	AOAC, 21st Edn, 2019, 984.13 Cha 4.2.09, Vol I Pg: 31
2.	Moisture	AOAC, 21st Edn, 2019, 925.10 Cha 32.1.03, Vol II Pg: 1
3.	Fat	AOAC, 21st Edn, 2019, 2003 Cha 4.5.05, Vol I Pg: 41
4.	Ash	AOAC, 21st Edn, 2019, 923.03 Cha 32.1.05, Vol II Pg: 2
5.	Carbohydrate	Biochemical Methods by S. Sadasivam et, al., Revised Second Edition;

		2005; Pg 8-9
6.	Crude Fibre	AOAC, 21st Edn, 2019, 962.09 Cha 4.6.01, Vol I Pg: 44
7.	Energy (Kcal.)	Food labelling- Requirement for FDA Regulated products by James L. Vetter E M. Melran, ED., AIB International Manhattan K.S 2007
8.	Soluble Dietary Fibre	AOAC, 16th Edn, 1997, 985.29, Cha 45.4.07, Vol II
9.	Insoluble Dietary Fibre	AOAC, 16th Edn, 1997, 985.29, Cha 45.4.07, Vol II

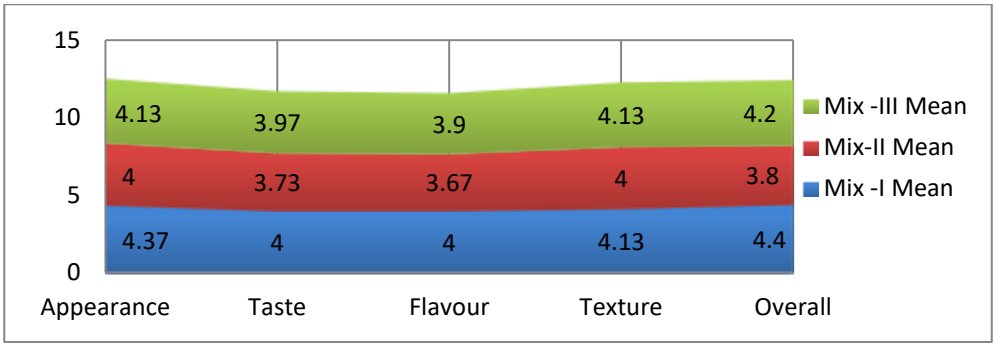
Results

Organoleptic evaluation of Pasta: Organoleptic Evaluation of Roasted Mix-I, Mix-II, Mix-III Flour Pasta. The texture, colour, and taste are the important features for admissibility.

Table-IV Mean of Organoleptic Evaluation Roasted Mix flour Pasta

Roasted	Mix I	Mix II	Mix III
	Mean+ Std. Deviation	Mean+ Std. Deviation	Mean+ Std. Deviation
Appearance	4.37± 0.61	4.00±0.78	4.13±0.77
Taste	4.00±0.69	3.73±0.64	3.97±0.71
Flavour	4.00±0.69	3.67±0.71	3.90±0.66
Texture	4.13±0.81	4.00±0.58	4.13±0.68
Overall	4.40±0.56	3.80±0.66	4.20±0.61

Figure-1 Mean of Organoleptic Evaluation of Roasted flour Mix-I, Mix-II, Mix-III



Organoleptic Evaluation of Roasted Mix flour Pasta Mix-I, Mix-II, Mix-III (ANOVA)

Table- V Mean of organoleptic evaluation of roasted mix flour pasta (ANOVA)

Sensory evaluation	Sources of variation	Sum of Squares	df	Mean Square	F	P
Appearance	Between Groups	2.067	2	1.033	1.936	0.150
	Within Groups	46.433	87	0.534		
	Total	48.500	89			
Taste	Between Groups	1.267	2	0.633	1.349	0.265
	Within Groups	40.833	87	0.469		
	Total	42.100	89			
Flavour	Between Groups	1.756	2	0.878	1.846	0.164
	Within Groups	41.367	87	0.475		

	Total	43.122	89			
Texture	Between Groups	0.356	2	0.178	0.360	0.699
	Within Groups	42.933	87	0.493		
	Total	43.289	89			
Overall	Between Groups	5.600	2	2.800	7.427	0.001
	Within Groups	32.800	87	0.377		
	Total	38.400	89			

Mix –I was selected from three variation of roasted mix flour as it possesses high score of organoleptic evaluation for further test and study.

Physical parameter of Selected Pasta: The Physical parameter of pasta such as Optimum Cooking Time, Cooked weight and Cooking Loss was checked and results are given in the table below.

Table- VI The Optimum Cooking Time, Cooked Weight and Cooking Loss of Roasted Mix – I, Flour Pasta

Pasta -25 g	**Roasted Mix-I**
OCT- Seconds	369
Cooked weight- g	60
Cooked weight % in gain in Weight	140
Cooking Loss – g	5.5
Cooking Loss % on Dry Weight	22

Physical Parameter of Selected Roasted Mix

The physical parameter such as bulk density, swelling index, water solubility index, anti-nutritional factors of the roasted mix-I flour were discussed below:

Table- VII The Bulk Density, Water Solubility Index, Swelling Index and Anti-nutritional Factors

Parameter	**Roasted Mix-I**
Bulk Density- g/ml	0.75
Swelling Index- %	4.6
Water Solubility Index- %	4.2
Anti – Nutritional Factors	-
Tannin- g/100 g	0.39
Total Phenolics- mg/g	73.8
Phytate- g/100 g	5.41
Saponins- g/100 g	11.97
Trypsin Inhibitors- TI/g	491

Physio- Chemical Nutrients analysis of Selected Mix- The physio- chemical nutrients analysis of Ash, Moisture, energy, carbohydrate, protein, fat and for fibre (Crude, soluble and Insoluble) were done for selected mix-I. The results are given below in the Table- VIII

Table- VIII Physio - Chemical Nutrients Analysis of Roasted Mix-I

		Parameter Analysed- g / 100g								
Sl. No	**Mix**	**Protein**	**Moisture**	**Fat**	**Ash**	**CHO**	**Crude Fibre**	**Energy Kcal**	**Soluble Fibre**	**Insoluble Fibre**
1.	**Roasted Mix –I**	14.205	2.540	3.120	2.511	77.623	0.683	395.396	4.77	2.79

Discussion

The Table- I the composition of whole wheat flour in all three mixes is 500 g, bengal gram flour is 50 g and cow pea flour are 50 g. The remaining ingredients such as yellow maize, pearl millet and barnyard millet alternate in proportion.

The Table II shows the mean and standard deviation of mix I, mix II and mix III in appearance, taste, flavor, texture and overall acceptability using roasting method. In Mix I, the mean for appearance is 4.37, mean for taste and flavor is 4, mean for texture is 4.13 and for overall acceptability the mean is 4.40. In Mix II, the mean score for appearance is 4, the mean score for taste is 3.73, the mean score for flavor is 3.67, the mean score for texture is 4, and the mean score for overall acceptability is 3.80. In Mix III, the mean for appearance is 4.13, 3.97 for taste, 3.90 for flavor, 4.13 for texture, and 4.20 for overall acceptability.

Hence as per high score of sensory evaluation of Mix-I (4.40) was selected for further study.

The Table- III presents the AOAC method of Physio- chemical nutrients analysis of Ash, Moisture, Energy, Carbohydrate, Protein, Fat and Fibre (Crude, soluble and Insoluble).

The Table IV presents the results of ANOVA computed to compare the acceptability among three mixes by roasting. There is significant difference between groups on overall acceptability at 0.01 levels. Moreover, no other statistical significance is found.

The Table- VI Show that the OCT of roasted mix-I flour pasta required 6 minutes 9 seconds, i.e. 369 seconds to get cooked. Cooked weight of roasted mix flour pasta was 60 gm i.e., 140 % and before cook weight was 25 g. The cooking loss of roasted mix pasta was 22%, this may be due to lack of gluten and enriched by millets and pulses.

The table-VII shows that the Bulk density of selected roasted Mix-I was 0.75 g/ml, swelling index was 4.6% whereas water solubility index was 4.2 % and anti-nutritional factors in roasted mix-I flour was Tannin-0.39g/100 g, total phenolics was 73.8 mg/g, phytate was 5.41g/100 g, saponins was 11.97 g/100g and trypsin inhibitors was 491 TI/g.

The Table- VIII show that the nutrient analysis of selected roasted Mix –I is that protein content per gram 14.205, moisture content 2.540, fat content 3.120, ash content 2.511, carbohydrate content 77.623 respectively. The energy of the selected roasted mix-I is 395.396 Kcal and crude fibre content was 0.683 while soluble dietary fibre is 4.77 g per 100 g and insoluble dietary fibre is 2.79 g/100 g respectively.

Statistical analysis: The final data was compiled and analyzed using suitable statistical methods. The results were presented as descriptive statistics such as mean, standard deviation, T-test and One Way (ANOVA). A level of p-value <0.05 was considered significant difference among the sample. Triplicate analyses were done for all nutritional, physical, and chemical parameters.

Conflict of interest: The authors declare they have no conflict of interests.

Conclusion

The Conclusion of study is that high fibre multi-mix formulated pasta is high in nutritional value as well fibre content with high acceptance score. Roasting of grains reduces the anti-nutritional factors which increases the bioavailability of micro nutrients. This multi-mix fibre rich pasta can be eaten by all age group with high bioavailability of micronutrients, with great health benefits.

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