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Chemical analysis of formulated cereal pulse based flour and development of value added products

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Abstract
In India malnutrition continues to be major public health problems. Diets lack in macro and micro nutrients so strategies are needed to emphasize an increase in total food intake, in addition to add greater variety. Hence present study was designed to formulate Cereal Pulse Based Blended Flours. Two flours were developed by using roasting method: Wheat-Moong Blend (WMU) and Wheat- Moth Blend (WMO). The moisture content of WMU and WMO was 3% and 6.16%, ash and protein content was more in WMU 3.3g and 14.23g respectively. Fat was estimated to be 4.46 g in WMU and 4.61g in WMO, crude fiber was estimated to be 5.48g in WMU and 4.50g in WMO samples respectively. The anti-nutrients composition of WMU and WMO was found to be oxalic acid being 9.2 mg in WMU and 7.3 mg in WMO, phytic acid content was 75 mg in WMU and 85.2 mg in WMO. For organoleptic sensory evaluation and acceptability trail, six standardized recipes (*Halwa, Cheela, Appe, Muffins, Atta-ladoo* and *Handwa*) were developed by using both the Flours which were further compared with the control recipes. Results reported that *Halwa, Cheela, Atta-Ladoo* and *Muffins* prepared from WMU blend were found to be more acceptable, where as *Handwa and Appe* prepared from WMO blend were more acceptable.

Keywords: Malnutrition, roasting, nutritional estimations, sensory evaluation, acceptability trail

1. Introduction
Malnutrition remains a major problem in most low-income countries causing 2.2 million deaths of children less than 5 years of age[1]. Moderate wasting affects 11% of the world's children and these children have a risk of death 3 times greater than that of well-nourished children[2]. Malnutrition not only makes a child more prone to illness and death, it may also have debilitating mental and physical consequences that the child carries into adulthood[3]. One of the major factors contributing to child malnutrition is inappropriate feeding during the weaning period, i.e. the period from 6 months to 18-24 months, when a transition is made from a diet exclusively of breast milk to a child's partaking fully in the family pot. During this period, special foods are required to supplement and eventually replace breast milk. However it has been reported that the foods (also called complementary foods) commonly given in community settings are often nutritionally inadequate, particularly lacking in micronutrients, not easy to swallow or digest, and frequently contaminated. As a result, a child consuming them does not receive all nutrient required for adequate growth and development.

Thus, there is need to develop and test new, inexpensive, and effective food supplements that could easily be used at the community level. Several researches have highlighted that recipes prepared by incorporating such mixtures like wheat soya blend or corn soya blend can be used both as a complementary food for primary prevention of under nutrition as well as supplemental feeding for moderately undernourished children [3]. Fortified Blended Flour (FBF) is used on a very large scale to feed populations in low income countries, especially malnourished individuals and vulnerable groups. The most common FBF are corn soy blend (CSB) and wheat soy blend (WSB) they are made from wheat or corn as the main staple, soy flour to improve the protein quality, a vegetable oil source, and a mix with mineral-vitamins to fortify the blend [4].

FBF were specifically developed for preschool-aged children and designed on the premise that beneficiaries' diets become sufficient in energy as well as in protein, vitamins, and essential minerals [5]. For improving the Protein efficiency of such blends it is usually recommended to add animal food like milk or egg etc. as it will enhance essential growth factor as well as higher bioactive proteins and the mixture will contain all the essential amino acids too. Through Nutrition Education Program community can be made aware of preparing such type of food at household levels or commercially they can be prepared and launched using simple techniques at reasonable price and distributed through government hospitals as well as by private clinics. This is one of the most effective way by which malnutrition can be managed and prevented at community level itself by enriching their existing diet through addition of such low cost formulas. Hence the present study was planned to develop Cereal Pulse Based Blended Flours and conduct certain nutritional and anti-nutritional estimations and develop certain recipes by using Wheat Pulse Based Blended Flours.

Materials and Methods
Sample Selection
Ingredients were procured from local market of Jaipur. The seeds were first cleaned and all the discolored and decayed seeds as well as other foreign materials were discarded. After washing the water was drained away and seeds were kept in air for drying. Once seeds are dried, they were roasted for 2 – 15 minutes at 85 degree Celsius and then powdered.

Nutritional and Anti-Nutrition Estimations
Samples were analyzed to evaluate nutrient composition of the premixes by using the standard techniques by using NIN

(2003) method [6]. The ash content was determined by Muffle-furnace method. The moisture content was determined by air-oven drying at 105º C for 8 hrs and the crude protein contents by micro Kjeldhal method. The fat content was determined using anhydrous ether in a Soxhlet extraction apparatus and crude fibre content by dilute acid and alkali hydrolysis. Antinutrients oxalic acid and phytic acid were estimated by practical manual of food analysis Kawatra (2000) [7]. Organoleptic evaluation and acceptability trail of all the recipes were done. Organoleptic evaluation of all the recipes was done by using five points hedonic rating scale on the basis of their appearance, color, taste, after taste and overall acceptability. Selection of recipes was done on the basis of their popularity, easy to prepare and serve. Easily acceptable and low cost recipes names are *Halwa, Cheela, Appe, Muffins, Atta-ladoo* and *Handwa.*

Results and Discussion

Nutritional and Anti-Nutritional Estimations

The results of nutritional and antinutritional estimations are highlighted in Table No1**.** Maximum moisture content (6.16%) was in the Wheat Moong Blend as compared to Wheat Moth Blend. The amount of ash estimated in fortified blended flour was 3.3±0.74g/100g (WMU) and 2.5±0.51g/100g (WMO). The ash content in WMU was maximum than WMO. Maximum protein content (14.23) was in Wheat Moong Blend as in compared to Wheat Moth Blend. Thakwalakwa *et al*, (2010) [8]. Carried out intervention and given two supplements LNS (Lipid- Nutrient Based Supplement) and Corn Soya Blend. The protein content of LNS and CSB was estimated 6.0 g/day and 10.4 g/day. Ndekha *et al*, (2009) [9]. Expressed protein content of Fortified Spread was 35.5g/ day and Corn Soya Blend Flour was 50 g/day. Supplements developed by Malilsky *et al*, (2009) [10]. CSB and Milk/ Peanut had protein content ranging between 34.4g/day and 18.9g/day. The protein content of Corn Soya Blend, Wheat Soya Blend and Corn Soya Milk used under World Food Programme was estimated to be 18g/100g; 20g/100g and 20g/100g [11]. Fat content of the both FBFs was in the range of 4.46 to 4.61 g/ 100 g. The fat content was highest in the FBF II and was minimum in FBF I. The ingredients which are included in FBFs are good source of fat. Thakwalakwa *et al* [8] carried out intervention and given two supplements LNS (Lipid- Nutrient Based Supplement) and Corn Soya Blend. The fat content of LNS and CSB was estimated 13.5 g/day and 3.1 g/day. Ndekha *et al* [9] provided two supplements fat content of Fortified Spread was 9g/ day and Corn Soya Blend Flour was 26.2 g/day. The fat content of Corn Soya Blend, Wheat Soya Blend and Corn Soya Milk used under World Food Programme was estimated to be 1.60MJ/100g; 1.55MJ/100g and 1.60MJ /100g [11]. The fiber content in both the sample was in the range of 4.50 to 5.48 g / 100 g with the highest level in the WMU followed and the minimum values of fiber were found in WMO. The oxalate content in the both BFs was in range of 9.2 to 7.3 mg/g respectively. Gradual decrease and the lowest value were observed in WMO. Reduction is the cause of water solubility property of oxalic acid. The phytic content in both BFs was in range of 75 to 85mg/g respectively. Lowest value of phytic acid was observed in WMU.

Organoleptic Evaluation and Acceptability Trail

Data regarding organoleptic evaluation of products in Table 2 revealed that *Halwa, cheela*, *Atta-ladoo* and *Muffins* were accepted which is made by WMU, *Handwa* and *Appe* was acceptable in WMO. Table 1 shows the mean and standard deviation of the score given to the product (*Handwa*) under different attributes. In both the fortified products, WMO was accepted the most by panel members as a mean score for overall acceptability were 5 in case of WMO and 4.6 for WMU. However, WMU had lower acceptability because it's rough texture and taste variation. But in comparison with Control the h*andwa* prepared by using FBFs were more acceptable. *Halwa* prepared by samples used WMU scored 4.6 and WMO 4 in terms of the overall acceptability. However, WMO, overall acceptability received the lowest score in case of both the BFs as mentioned in the Table 2. In *cheela,* WMO reduced its acceptability because it resulted less in color, taste and texture. In both the FBFs, WMU was accepted most by the panel members as the mean score and overall acceptability were 4.6 in WMU and 4.2 for WMO. However, color of both the BFs was same and also resulted rough in texture. However, WMO, overall acceptability received the lowest score in case of both the BFs as compared to control as mentioned in the Table 2.

Mean scores for color, appearance, texture and taste obtained by WMU sample of *Atta-Ladoo* were ranging from 4.4 to 4.8 with an overall acceptability score of 4.8 and was liked very much. A significant difference was observed between control and WMU sample. The mean scores for overall acceptability were lowest for C i.e. 4.2. Mean scores obtained by FBF II sample of *App*e were ranging from 4.2 to 4.6 with an overall acceptability score of 4.6 which was also liked good as compared to WMU. Control was more liked by the panel members. Overall acceptability scores of WMU, *Muffins* was 4.4 which was liked moderately and difference was observed in color, appearance, taste and texture for WMO and control samples. As compared to WMU, WMO was unacceptable because of its rough texture and bitter taste. Acceptability trail of all the recipes were done of both the Wheat Pulse Based Blended Flours.

The results of organoleptic evaluation were statistically evaluated using t test and results highlighted that there was no significant difference between the products prepared using standard and Wheat Pulse Based Blended Flours. The Wheat Pulse Based Blended Flours were more nutritious in comparison to standard flour besides this the sensory attributes of products were comparable.

Table 1: Nutritional Estimations of Wheat Pulse Based Blended Flours (g/ 100 g)

Nutritional Estimations	WMU	WMO
Moisture content (%)	3.3±1.04	6.16±1.04
Ash content(gm)	3.3±0.74	2.5±0.51
Protein content(gm)	14.23±0.27	13.12±0.39
Fat content(gm)	4.46±1.20	4.61±0.59
Crude Fiber content(g)	5.48±0.40	4.50±0.36
Oxalic acid(mg)	9.2±1.97	7.3±1.56
Phytic acid(mg)	75±1.11	85.2±0.91

WMU- Wheat Moong Blend, WMO- Wheat Moth Blend

Table 2: Organoleptic evaluation of developed products by Wheat Pulse Based Blended Flours

Products	Appearance	Color	Texture	Taste	Overall Acceptability
Handwa					
Control	4.6±0.5	4.6±0.5	4.6±0.5	4.6±0.5	4.6±0.5
WMU	5±0	5±0	4.4±0.5	4.6±0.5	4.6±0.5*
WMO	4.8±0.4	4.8±0.4	5±0	5±0	5±0*
Halwa					
Control	4.8±0.4	4.6±0.5	4.8±0.4	4.6±0.5	4.8±0.4
WMU	4.8±0.4	4.4±0.5	4.8±0.4	4.4±0.5	4.6±0.5*
WMO	4.2±0.4	4±0	4.2±0.4	4±0	4±0*
Cheela					
Control	4.8±0.4	4.8±0.4	4.4±0.5	4.6±0.5	4.8±0.4
WMU	4.8±0.4	4±0	4.4±0.5	4.6±0.5	4.6±0.5*
WMO	4.6±0.5	4±0	4±0	4.4±0.5	4.2±0.4*
Atta-ladoo					
Control	4.8±0.4	4.8±0.4	5±0	4.8±0.4	5±0
WMU	4.4±0.5	4.4±0.7	4.8±0.4	4.8±0.4	4.8±0.4*
WMO	4±0	4±0	4±0.7	4.4±0.5	4.2±0.4*
Appe					
Control	4.8±0.4	4.6±0.5	4.4±0.5	4.2±0.4	4.8±0.4
WMU	4.4±0.9	4.4±0.5	4.4±0.5	4.4±0.5	4.4±0.5*
WMO	4.2±0.8	4.4±0.9	4.4±0.9	4.6±0.9	4.6±0.9*
Muffins					
Control	4.8±0.4	4.8±0.4	4.8±0.4	4.8±0.4	4.8±0.4
WMU	3.8±1.09	4.2±0.4	3.8±1.09	4.2±0.8	4.4±0.5*
WMO	3.6±0.8	4±0	3.6±0.89	3.6±0.89	3.8±0.4*

*NS =No significant difference
Control- Standardized Recipe

Conclusion

From above it results reported that *Halwa, Cheela, Atta-Ladoo* and *Muffins* prepared from WMU blend were found to be more acceptable, where as *Handwa and Appe* prepared from WMO blend were more acceptable. The sensory attributes of products were comparable and it is found that Wheat Pulse Based Blended Flours were nutritious in comparison to standard. The Wheat Pulse Based Blended Flours were developed for preschool-aged children made to combat malnutrition. It is made at household levels or commercially they can be prepared and launched using simple techniques at reasonable price. This is one of the effective way by which malnutrition can be managed and prevented at community level itself.

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