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# Developing cereal pulse supplementary snack for pre-schoolers

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**Abstract**

Malnutrition is prevalent among the rural segments of the population that predisposes recurrent infections. Often malnutrition in children is the major factor for morbidity. An attempt was made to develop suitable nutritious supplementary snack for preschool children with locally available foods. A supplementary snack was developed in different combinations and was evaluated for nutrient adequacy, acceptability, cost and shelf life qualities. All the products were found to be acceptable and among the different supplements developed barley based products were found to have better sensory qualities.

**Keywords**:-*malnutrition, supplementary snack, Nutrient adequacy, shelf life, Barley, sensory qualities*

## 1. Introduction

In the year 2011 around 6.9 million children died in the age group "under five" world-wide only because of the susceptibility to illness as a result of the risk factors such as low birth weight, inadequate breast feeding, and improper supplementary feeding that predispose recurrent infections. (Bhutta 2012)

India is one of the few countries where poor nutritional status among preschool children is detrimental to their health outcome and under nutrition is found to be the most common health problem in the third world countries

Kerala is known world over for its high human development achievements attained without much rural urban disparities and caste class differentiation, the state is now facing serious threats in the field of nutritional status among preschool children.

The literacy level is high in Kerala but many parents lack nutritional awareness and once the child starts going to school the attention of the parents are diverted to their school performance alone and health of the child becomes a secondary matter. As a result the growth retardation sets in due to lack of adequate food during the growing stage.

As per the standards set by CFTRI and known organisations supplementary foods should have an energy source generally a cereal, a protein source pulses along with oilseeds that mutually supplement each other to become a complete food.

In this experiment rice, wheat, barley Bengal gram, green gram, cowpea (red), ground nut, coconut, sesame along with jaggery and ghee formed the ingredients for the supplementary snack food. All the ingredients were selected keeping in mind of the high calorie, high bioavailability, and at the same time local availability and low cost. ( Food composition table 2016 NIN )

The major aim of this study is to develop an innovative energy packed supplementary snack balls for preschool children giving emphasis in the traditional snack pattern using locally available ingredients.

**The present experiment has the following objectives**

1. Standardisation of different ceral-pulse combinations so as to make high calorie acceptable supplementary food
2. Analysis of the nutritional composition of the formulated products
3. Sensory evaluation and cost of the products
4. Shelf life qualities of the developed products

## 2. Materials and methods

**Procurement of materials**

Rice, wheat, barley, bengal gram, greengram cowpea (red), sesame,coconut and groundnut were procured from the local market in Malappuram District, Kerala. All the ingredients were cleaned dried and roasted and finely ground separately.

**Food product development**

The food product development using rice, wheat, barley, bengal gram, green gram, cow pea (red) and sesame ground nut, coconut produced 27 combinations. These 27 combinations were blended with jaggery and ghee and made laddus of 50g each. These 27 combinations were subjected to preference test among the panel members and out of this 1/3 that is 9 combinations were selected based on the maximum score got for organoleptic qualities.

| 60g cereal | 30g pulses | 10g oilseeds |
|---|---|---|
| rice | bengal gram | sesame |
| wheat | green gram | groundnut |
| barley | cowpea(red) | coconut |

Mix 1 rice, bengalgram, sesame
Mix 2 rice, greengram, groundnut
Mix 3 rice, cowpea, coconut
Mix 4 wheat, bengalgram, groundnut
Mix 5 wheat, greengram, coconut
Mix 6 wheat, cowpea, sesame
Mix 7 barley, bengalgram, coconut
Mix 8 barley, greengram, sesame
Mix 9 barley, cowpea, groundnut

Every combination of mix of 100g are blended with 75g jaggery and 25g ghee and made in to laddu of 50g each.

**Nutrient composition**

Nutrient composition of different supplementary snack food was carried outusing nutritive value of Indian foods NIN ICMR.

**Sensory Evaluation**

Sensory evaluation was done by using the 9 point Hedonic rating scale. 10 panel members were selected through triangle difference test.

**Economic Evaluation**

The economic evaluation of the developed products were done by taking in to account of the yield ratio of the developed products,preparation loss of the developed products,and total cost of the product were calculated.

**Shelf life of the products**

Shelf life of a food is sometimes defined as the time taken to decline to an unacceptable level in organoleptic qualities. In this experiment for assessing the shelflife qualities of the developed products the samples were drawn randomly in required quantity and kept in airtight containers. In this experiment shelf life of the products were assessed by the time taken for the product to show change in flavour due to rancidity as well as visible microbial and fungal growth.

**Stastical Analysis**

Data were analysed statistically by Mean standard deviation one factor ANOVA and Tukey's simultaneous comparison of t values.

## 3. Result and discussion

The **Table.1** details the nutrient composition analysis of the developed products which indicate that energy value of rice based products had a range of 882-888 kcal/200g. In the case of wheat and barley it was in a range of 873-886 Kcal and 870-891 Kcal / 200g. However there

was no significant variation at 5% level with respect to energy value and all the combinations were equally acceptable

In the case of protein content for rice products it was 12.8-16.9g and for wheat and barley combinations 15-16g and 14-16.5 g respectively.

The calcium content of rice wheat and barley combinations ranged from 128-227mg, 113-256mg and 105-342mg respectively.

The phosphorous content of rice wheat and barley ranged from 258-354mg, 287-391mg and 239-287mg

The energy, protein, calcium, and phosphorous content of the products were not significantly varied and all are equally acceptable.

A similar micronutrient rich supplement food (ball) was developed by using wheat germ, gingelly seeds, riceflakes, dried carrot powder along with jaggery and found acceptable, with a protein content19.5g,energy 350kcal, calcium 150 mg, iron 9.29 mg and zinc10.64mg per 100g product.**(**Narayanasamy *S etal* 2010).

The CFTRI had developed similar supplementary food as “energy Food” which was ready to eat and which can be used as gruel or laddu. The supplementary food was based on wheat, Bengal gram dhal defatted protein rich oilseeds and malted cereals and the energy was 360Kcal and protein 15g and was acceptable as a weaning/nutritious food for preschool children.

A supplementary food panjiri (Mehrajfatema ZM 2011 ) was developed using wheat flour, soya flour and chick pea flour using household technologies like roasting and blending. The energy ranged 350.7-395.8Kcal and protein 12.2-19.6g/100g.

The iron content of rice wheat and barley ranged between 5.1-6.2mg, 6.6-6.9mg, 4.4-5.4mg respectively. A multiple comparison of nutrients (**Table 2)** revealed that the iron content of wheat was significantly different with barley.

Only four essential amino acids are likely to affect the protein quality of mixed human diets: lysine, the sulfur-containing amino acids (methionine plus cystine), threonine, and tryptophan. So in the present experiment analysed the above essential aminoacids. The lysine and threonine are abundant in rice ranges from 39-48mg, and 40-61mg and it was significantly different with wheat combinations.The tryptophan content is more in barley combinations 53-64mg. Tryptophan content it was significantly different with wheat and on par with rice combinations.The cost of the products in **Table 1** indicate that for 50g product the cost ranges for rice 3-4.25 Rs, wheat 3.30-4 Rs and barley 3-4.50 Rs, all are acceptable in the economic point of view.

**Sensory Analysis**

The sensory analysis of the data **Table 3** indicate MIX 8 with barley green gram sesame combinations had the highest score 31.1. It was observed that the data presented were statistically significant with p value 0.00.Hence stepped on to Tukey significant with MIX 5,2,4,9,6,3 and MIX 1. The MIX7 with barley combinations on par with better sensory qualities. The Figure 1 shows the picture of sensory acceptance of the products**.**

The shelf life qualities of the products were in good condition up to 3weeks without any rancid flavour and visible microbial growth.

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**Table 1. Nutrient Composition Analysis of the developed products**

| Nutrients/200g | | N | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Energy | Rice | 3 | 886 | 3.4641 | 882 | 888 |
| | Wheat | 3 | 881.333 | 7.2342 | 873 | 886 |
| | Barley | 3 | 878 | 11.3578 | 870 | 891 |
| | Total | 9 | 881.778 | 7.7746 | 870 | 891 |
| Protein | Rice | 3 | 15.033 | 2.0744 | 12.8 | 16.9 |
| | Wheat | 3 | 15.667 | 0.5774 | 15 | 16 |
| | Barley | 3 | 15.633 | 1.4154 | 14 | 16.5 |
| | Total | 9 | 15.444 | 1.3249 | 12.8 | 16.9 |
| Calcium | Rice | 3 | 183.333 | 50.5206 | 128 | 227 |
| | Wheat | 3 | 206.333 | 80.8847 | 113 | 256 |
| | Barley | 3 | 193 | 129.7421 | 105 | 342 |
| | Total | 9 | 194.222 | 81.1292 | 105 | 342 |
| Phosphorous | Rice | 3 | 307.333 | 48.0555 | 258 | 354 |
| | Wheat | 3 | 352.333 | 56.8976 | 287 | 391 |
| | Barley | 3 | 268.333 | 25.7164 | 239 | 287 |
| | Total | 9 | 309.333 | 53.64 | 239 | 391 |
| Iron | Rice | 3 | 5.533 | 0.5859 | 5.1 | 6.2 |
| | Wheat | 3 | 6.767 | 0.1528 | 6.6 | 6.9 |
| | Barley | 3 | 4.833 | 0.7371 | 4 | 5.4 |
| | Total | 9 | 5.711 | 0.9727 | 4 | 6.9 |
| Lysine | 1 | 3 | 43.667 | 4.5092 | 39 | 48 |
| | 2 | 3 | 30.333 | 2.0817 | 28 | 32 |
| | 3 | 3 | 35.667 | 5.5076 | 32 | 42 |
| | Total | 9 | 36.556 | 6.894 | 28 | 48 |
| Threonine | 1 | 3 | 52.333 | 10.9697 | 40 | 61 |
| | 2 | 3 | 31.333 | 0.5774 | 31 | 32 |
| | 3 | 3 | 34.333 | 4.9329 | 31 | 40 |
| | Total | 9 | 39.333 | 11.5326 | 31 | 61 |
| Tryptophn | 1 | 3 | 56 | 6.0828 | 49 | 60 |
| | 2 | 3 | 43.333 | 0.5774 | 43 | 44 |
| | 3 | 3 | 56.667 | 6.3509 | 53 | 64 |
| | Total | 9 | 52 | 7.8581 | 43 | 64 |
| SAA | 1 | 3 | 80.667 | 25.3246 | 52 | 100 |
| | 2 | 3 | 53 | 1 | 52 | 54 |
| | 3 | 3 | 50.333 | 7.7675 | 44 | 59 |
| | Total | 9 | 61.333 | 19.6787 | 44 | 100 |
| Cost/50g | 1 | 3 | 3.75 | 0.66144 | 3 | 4.25 |
| | 2 | 3 | 3.6 | 0.36056 | 3.3 | 4 |
| | 3 | 3 | 4.25 | 0.43301 | 3.75 | 4.5 |
| | Total | 9 | 3.8667 | 0.525 | 3 | 4.5 |

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**Table 2. Multiple comparisons for nutrients**

| Multiple Comparisons | | | | | | | |
|---|---|---|---|---|---|---|---|
| Scheffe | | | | | | | |
| Dependent Variable | (I) PRODUCT | (J) PRODUCT | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
| | | | | | | Lower Bound | Upper Bound |
| Iron | 1.0 | 2.0 | -1.2333 | 0.4497 | 0.087 | -2.676 | .209 |
| | | 3.0 | .7000 | 0.4497 | 0.361 | -.742 | 2.142 |
| | 2.0 | 1.0 | 1.2333 | 0.4497 | 0.087 | -.209 | 2.676 |
| | | 3.0 | 1.9333* | 0.4497 | 0.015* | .491 | 3.376 |
| Lysine | 1.0 | 2.0 | 13.3333* | 3.4960 | 0.025* | 2.121 | 24.546 |
| | | 3.0 | 8.0000 | 3.4960 | 0.152 | -3.213 | 19.213 |
| | 2.0 | 1.0 | -13.3333* | 3.4960 | 0.025 | -24.546 | -2.121 |
| | | 3.0 | -5.3333 | 3.4960 | 0.374 | -16.546 | 5.879 |
| Threonine | 1.0 | 2.0 | 21.0000* | 5.6765 | 0.028* | 2.794 | 39.206 |
| | | 3.0 | 18.0000 | 5.6765 | 0.052 | -.206 | 36.206 |
| | 2.0 | 1.0 | -21.0000* | 5.6765 | 0.028 | -39.206 | -2.794 |
| | | 3.0 | -3.0000 | 5.6765 | 0.872 | -21.206 | 15.206 |
| Tryptophn | 1.0 | 2.0 | 12.6667 | 4.1544 | .060 | -.658 | 25.991 |
| | | 3.0 | -.6667 | 4.1544 | .987 | -13.991 | 12.658 |
| | 2.0 | 1.0 | -12.6667 | 4.1544 | .060 | -25.991 | .658 |
| | | 3.0 | -13.3333* | 4.1544 | .050* | -26.658 | -.009 |
| | 3.0 | 1.0 | .6667 | 4.1544 | .987 | -12.658 | 13.991 |
| | | 2.0 | 13.3333* | 4.1544 | .050 | .009 | 26.658 |
| *. The mean difference is significant at the 0.05 level. | | | | | | | |

Table. 3.One factor ANOVA sensory analysis

| Product | *Mean* | *n* | *Std. Dev* | Ingredients |
|---|---|---|---|---|
| 1. MIX 1 | 28.4 | 10 | 2.84 | Rice, bengal gram, sesame jaggery, ghee |
| 2. MIX 2 | 26.0 | 10 | 2.00 | Rice, greengram, groundnut ,jaggery, ghee |
| 3. MIX 3 | 27.9 | 10 | 1.29 | Rice, cowpea, coconut, jaggery, ghee |
| 4. MIX 4 | 27.0 | 10 | 1.33 | Wheat ,bengalgram ,groundnut, Jaggery, ghee |
| 5. MIX 5 | 25.1 | 10 | 1.37 | Wheat, greengram, coconut, jaggery, ghee |
| 6. MIX 6 | 27.6 | 10 | 2.27 | Wheat ,cowpea, sesame, jaggery Ghee |
| 7. MIX 7 | 29.2 | 10 | 1.48 | Barley, bengalgram, coconut, jaggery, ghee |
| 8.MIX 8 | 31.1 | 10 | 1.66 | Barley, greengram, sesame, jaggery Ghee |
| 9.MIX 9 | 27.0 | 10 | 1.25 | Barley, cowpea, groundnut ,jaggery, Ghee |
| Total | 27.7 | 90 | 2.40 | |

ANOVA table

| *Source* | *SS* | *df* | *MS* | *F* | *p-value* |
|---|---|---|---|---|---|
| Treatment | 249.80 | 8 | 31.225 | 9.69 | 0.000 |
| Error | 261.10 | 81 | 3.223 | | |
| Total | 510.90 | 89 | | | |

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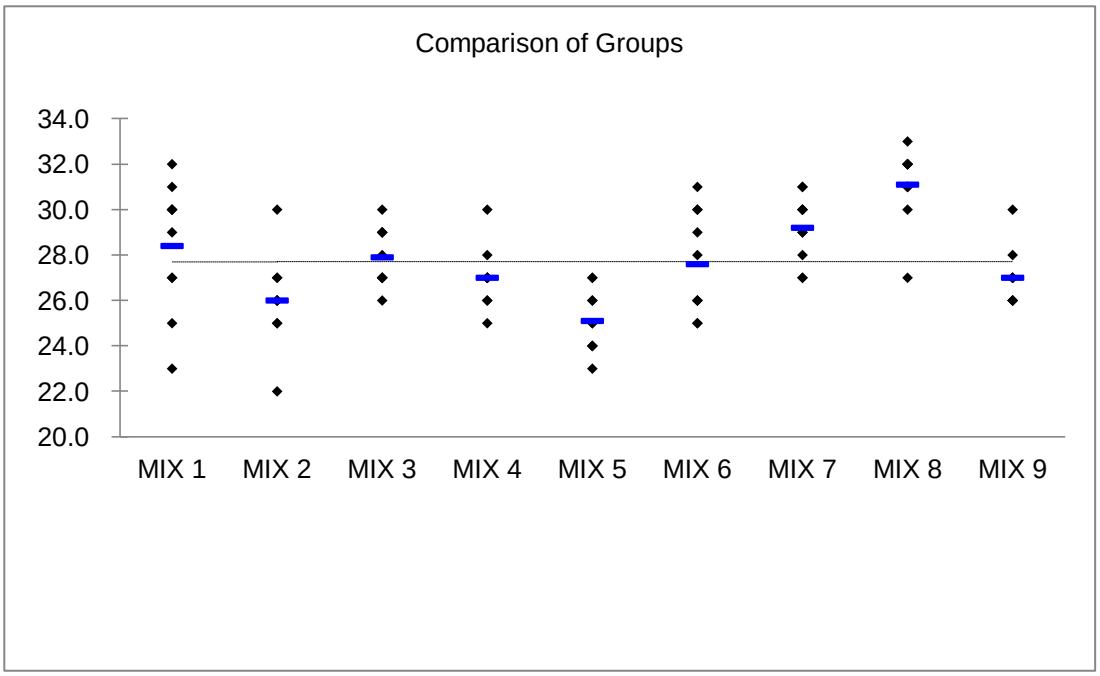
**Table 4.Sensory analysis**

| *Post hoc* analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Tukey simultaneous comparison t-values (d.f. = 81) | | | | | | | | | | |
| | | MIX 5 | MIX 2 | MIX 4 | MIX 9 | MIX 6 | MIX 3 | MIX 1 | MIX 7 | MIX 8 |
| | | 25.1 | 26.0 | 27.0 | 27.0 | 27.6 | 27.9 | 28.4 | 29.2 | 31.1 |
| MIX 5 | 25.1 | | | | | | | | | |
| MIX 2 | 26.0 | 1.12 | | | | | | | | |
| MIX 4 | 27.0 | 2.37 | 1.25 | | | | | | | |
| MIX 9 | 27.0 | 2.37 | 1.25 | 0.00 | | | | | | |
| MIX 6 | 27.6 | 3.11 | 1.99 | 0.75 | 0.75 | | | | | |
| MIX 3 | 27.9 | 3.49* | 2.37 | 1.12 | 1.12 | 0.37 | | | | |
| MIX 1 | 28.4 | 4.11* | 2.99 | 1.74 | 1.74 | 1.00 | 0.62 | | | |
| MIX 7 | 29.2 | 5.11* | 3.99* | 2.74 | 2.74 | 1.99 | 1.62 | 1.00 | | |
| MIX 8 | 31.1 | 7.47* | 6.35* | 5.11* | 5.11* | 4.36* | 3.99* | 3.36* | 2.37 | |
| critical values for experiment wise error rate: | | | | | | | | | | |
| | | 0.05 | 3.20 | | | | | | | |

**Figure1.SensoryAnalysis**




## 4. Conclusion

The experiment concluded that all the products developed were equally acceptable with respect to their nutrient composition and cost of the products. In sensory evaluation barley based products showed better organoleptic qualities. All the products were low in cost and can be supplemented in the local population for combating energy malnutrition.

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