The AJAS THE ASIAN JOURNAL OF ANIMAL SCIENCE
Volume **13** | Issue 1 | June, 2018 | 31-36
◆ e ISSN–0976–8963
DOI : 10.15740/HAS/TAJAS/13.1/31-36
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***RESEARCH ARTICLE*.....**

Optimization of (Ragi) finger millet and whey protein concentrate level in weaning food

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ABSTRACT..... Ragi is one of the main crops of Karnataka.Whey is rich in lactose, whey proteins, water soluble vitamins and minerals. Apart from nutrients, whey proteins are also potential ingredients in a wide range of food applications due to their excellent nutritional and promising functional properties. The presently available commercial weaning foods are focused mainly on nutritional requirements but not much on any of the health benefits. Hence, a study was undertaken develop a technology for formulation of functional weaning foods. The malted wheat flour used in the formulation was replaced with malted Ragi at various levels and similarly malted green gram was replaced with various levels of WPC. With increase in the level of Ragi malt from 0 to 50 per cent replacement there was significant improvement in the scores pertaining to sensory attributes there after the scores decreased.With increasing in the level of WPC there was significant improvement in sensory acceptability of the product upto a level of 30 per cent replacement. Substitution of green gram protein with WPC had significant effect on overall acceptability attribute upto 30 per cent. From the study it was concluded that the best quality weaning food could be prepared with the blend containing the blend of wheat and Ragi at the ratio of 50:50 and with the Green gram substitution with WPC upto 30 per cent level without affecting the acceptability of the weaning food. The morbidity and mortality encountered in infants could be counteracted effectively by feeding Ragi and whey protein containing functional weaning foods.

KEY WORDS..... Weaning food, Whey proteins, *Ragi*, Finger millet, Millet malting

HOW TO CITE THIS ARTICLE - Mahadevaiah, Jayaprakasha, H.M. and Suresha, K.B. (2018). Optimization of (Ragi) finger millet and whey protein concentrate level in weaning food. *Asian J. Animal Sci.*,**13**(1): 31-36. **DOI : 10.15740/HAS/TAJAS/13.1/31-36.**

ARTICLE CHRONICLE - Received **:** *03.03.2018;* Revised **:** *21.05.2018;* Accepted **:** *30.05.2018*

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INTRODUCTION.....

Weaning refers to introduction of food other than mother's milk or complete discontinuation of breast milk or introduction of solids to diet. Generally the term weaning is used to denote the process in which infant changes from breast milk to mixed diet (Macrae *et al.*, 1993). It is the process of expanding the diet to include food and drinks other than breast milk or infant formula as it is the period of infant vulnerability (Sajilata *et al.*, 2002). It represents a period of dietary transition, just

when nutritional requirements for growth and brain development are high. Observations of traditional child feeding practices in many developing countries reveal that, weaning period is the whole period during which breast milk is being replaced by other foods, usually starts when infant is 4-6 months old and is expected upto the age of two to three years (Alexander, 1983). Weaning is an important period in the life of a baby. When an infant attains 4-6 months of age, breast milk alone is no longer sufficient to meet its nutritional requirements. Thus, complementary feeding begins when breast milk alone is no longer sufficient to meet the nutritional requirements of infants and therefore other foods and liquids are needed along with breast milk (Weaver, 1994). Faulty feeding during weaning and post weaning period becomes a cause for occurrence of a variety of nutritional diseases among children. Protein energy mal-nutrition is a nutritional deficiency problem among infants and children especially in poor socio-economic groups. Protein energy malnutrition is an important nutritional deficiency condition that often occurs during the critical transitional phase of weaning infants, crippling their physical and mental growth. This could be due to progressive decline in the incidence of breast feeding observed during the last 25-30 years (Acharya and Shah, 1998). This condition can be prevented to a large extent by introducing weaning foods of good quality and quantity at right proportion and at right stage (Pawar and Dhanvijay, 2007). Protein energy mal-nutrition generally occurs during the crucial transitional phase when children are introduced to family diet. Inspite of the advances made in recent years in upgrading the nutritional characteristics of weaning foods, susceptibility of infants to enteropathogenic organisms still constitutes the largest health risk. Cereals contribute approximately 50 per cent of calorie, protein requirements and important sources of B vitamins, minerals and dietary fibre in normal food consumption. It constitutes 60 per cent of the total global harvest of foods. India is responsible for approximately half of the world's production of finger millet grain (Tripathy *et al.,* 2003). Ragi is one of the main crops of Karnataka. Malting/ germination is one of the important food processing technologies practiced from ancient times throughout the world and has much technological and nutritive relevance in terms of increase in vitamin, lysine and tryptophan contents and decrease in viscosity, which are of great significance in development of weaning food. Even though cereals and legumes are the basic ingredients for weaning foods, many attempts have been made to replace vegetable protein with milk protein especially whey protein. Whey is rich in lactose, whey proteins, water soluble vitamins and minerals. Because of their high quality proteins, particularly the sulphur containing amino acids and acts as a balancing ingredient in weaning food formulation (Makhal *et al.,* 2003). Apart from nutritional point of view, whey proteins are also potential ingredients in a wide range of food applications due to their excellent nutritional and promising functional properties. The presently available commercial weaning foods are focused mainly on nutritional requirements but not much on any of the health benefits. Hence, there is a need to develop a technology for formulation of functional weaning foods. The functional weaning foods thus developed add on to the health benefits of young children besides meeting their nutritional requirements. The morbidity and mortality encountered in infants can be counteracted effectively by feeding such functional weaning foods. Keeping in view the above facts, this investigation was taken up.

RESEARCH METHODS.....

The ingredients used in the investigation namely Ragi, wheat, green gram, sugar, refined sunflower oil, multivitamins, corn starch, sugar and Daber honey were procured from the local market. Whey protein concentrate (WPC) (PROCON 3700 WPC 70) was procured from Mahaan Protein Ltd., New Delhi. Poly ethylene terephthalate (PET) and high density poly ethylene (HDPE) were procured from Shakthi packaging company, Bangalore. The chemicals and reagents used were of analytical grade. For all analytical purpose freshly prepared reagents were used.

The ingredients used in the formulation of functional weaning food were preprocessed by following standard protocol before used in the formulation. Ragi malt flour was prepared as per the procedure described by Swamy (2003) with slight modification. The whole malted wheat flour was prepared as per the procedure of Taragopal *et al.* (1982). The green gram malt was prepared as per the procedure outlined by Malleshi (1995). The malted flours thus, obtained were sieved using 60 mm mesh sieve and stored in clean airtight container until used. The functional malted weaning food was formulated by using malted Ragiflour, malted wheat flour, malted green gram

flour, hydrolyzed WPC, sugar, oil and multivitamins besides supplementation with probiotics.

Based on the desired nutritional requirements profile of the weaning food base blend containing 30 parts of cereals/ millets, 38 parts pulses, 24 parts sugar and 8 parts of oil was prepared as per the procedure outlined by Swamy (2003). In the portion of 30 parts of cereals/ millets base, wheat malt was replaced with Ragi malt at 25, 50, 75 and 100 per cent levels. The blends were subjected to chemical and sensory evaluation studies after cooking to make into porridge in order to select the right levels of Ragi malt that could be incorporated in the weaning food. The optimized weaning food with respect to malted Ragi was further tried with WPC for replacing malted green gram. The malted green gram powder used in the study was replaced with WPC at various levels (0, 10, 20, 30 and 40 %). The blends were reconstituted to 25 per cent TS and cooked and made into porridge. The resultant gruel was subjected to chemical and sensory evaluation attribute studies in order to select the right level of replacement of green gram with WPC. The formulated weaning food was packed in HDPE and PET packaging material under normal and modified atmospheric packaging conditions. The moisture content of all the ingredients and samples were estimated as AOAC (1984). The total protein content of the dried samples of ingredients as well as final functional weaning food was computed by estimating total nitrogen by the Micro-Jeldhal method. Fat content was estimated by ether extract method as per the procedure of AOAC (1980). Total ash content of the developed weaning foods was analysed as per the procedure of AOAC (1980). Crude fibre of the sample was estimated by using moisture and fat-free samples and expressed as g/ 100g or per cent of the samples used as per AOAC (1984). Carbohydrate content was calculated by differential method as per AOAC (1980). Sensory evaluation of samples was carried out by a panel of 5 in house judges by providing 9 point hedonic scale. The results were analyzed statistically for test of significance by using statistical packages for social sciences (SPSS) version 8 software programme.

RESEARCH FINDINGS AND ANALYSIS.....

The malted wheat flour used in the formulation was replaced with malted Ragi at various levels and similarly malted green gram was replaced with various levels of WPC. Results obtained in the process of optimization are presented here under. The malted wheat flour used in the standard formulation was replaced with malted Ragi flour at 25, 50, 75 and 100 per cent levels. The effect of replacement of malted wheat flour with malted Ragi on chemical composition and sensory quality of weaning food is presented in Table 1.

The moisture content of the experimental sample varied between 4.44 to 4.10 whereas it was 4.62 per cent for the control. There was no significant difference in the fat content of the weaning food prepared by replacing wheat malt with Ragi malt. However, there was significant decrease in the protein content with increase in the level of substitution of wheat malt with Ragi malt. The extent of replacement of wheat malt with Ragi malt had no significant effect on the carbohydrates contents of the weaning food. The carbohydrate content varied between 71.61 to 72.15 per cent. A significant increase in ash content was noted with increase in the level of substitution of malted wheat flour with Ragi flour. Weaning food prepared exclusively with malted wheat had 1.50 per cent ash content whereas weaning food prepared exclusively with Ragi malt had an ash content as high as 2.98 per cent. The replacement of malted wheat flour with malted Ragi was found to have

Table 1: Effect of replacement of wheat malt with Ragi malt on chemical composition of weaning food

Level of Ragi malt: wheat malt	Moisture (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Ash (%)	Crude fibre (%)	Energy density (K.cal/100g)
Control	4.62	8.55	13.72	71.61	1.50	1.48	418.27
25:75	4.44	8.58	13.30	71.85	1.83	1.61	417.82
50:50	4.33	8.65	12.95	71.90	2.17	1.78	417.25
75:25	4.15	8.73	12.54	71.97	2.61	1.99	416.61
100:0	4.10	8.84	11.93	72.15	2.98	2.14	415.88
F ratio	*	NS	*	NS	*	*	NS
C.D. (P=0.05)	0.011	---	0.120	---	0.310	0.100	---

All values are average of three trials * indicate significance of value at P=0.05 NS= Non-significant

significant effect with respect to crude fibre content of weaning food. The energy density of the weaning food was 418.27 k cal/100g for control sample whereas it was 415.88 k cal/100g for the weaning food exclusively prepared by completely replacing wheat malt flour with Ragi malt. A slight decrease energy density was observed with increase in the level of Ragi malt in the weaning food.

The result pertaining to the use of Ragi malt in weaning food and its effect on sensory qualities is presented in Table 2. With the increase in the level of Ragi malt from 0 to 100 per cent there was significant decrease in the scores pertaining to color and appearance. The scores for weaning food prepared exclusively with malted wheat was 8.00. With increase in the level of Ragi malt from 0 to 50 per cent replacement there was significant improvement in the scores pertaining to flavour attributes there after the scores decreased.

Similarly, consistency of the weaning food improved upto 50 per cent replacement of wheat with Ragi malt. The scores pertaining to overall acceptability attributes increased with increase in the level of Ragi malt in the weaning food upto 50 per cent level. Further increased level of replacement significantly decreased the score with respect to overall acceptability attributes.

Weaning food was formulated by the admixture of malted wheat flour and malted Ragi flour (50:50), along

Table 2: Effect of replacement of wheat malt with Ragi malt on sensory qualities of weaning food

Level of Ragi malt:wheat malt	Sensory attributes (Max. score: 9.00)			
	Colour and appearance	Flavour	Consistency	Overall acceptability
Control	8.00	7.90	7.95	8.05
25:75	7.80	8.11	8.15	8.17
50:50	7.52	8.32	8.29	8.32
75:25	6.80	7.73	7.58	7.61
100:0	6.05	6.10	6.70	6.56
C.D. (P=0.05)	0.150	0.201	0.120	0.110

All values are average of three trials

Table 3: Effect of substitution of green gram protein with whey protein concentrate on energy and chemical characteristics of weaning food

Level of substitution (w/w %)	Moisture (%)	Acidity (% LA)	Fat (%)	Protein (%)	Carbo-hydrates (%)	Ash (%)	Crude fibre (%)	Energy density K cal/100g
Control*	4.62	1.45	8.55	13.72	71.61	1.50	1.48	418.27
10	4.59	1.47	8.61	14.34	70.69	1.77	1.37	417.61
20	4.56	1.49	8.70	15.57	69.23	1.94	1.28	417.50
30	4.52	1.52	8.82	16.86	67.62	2.18	1.19	417.30
40	4.49	1.58	8.91	18.08	66.15	2.37	1.09	417.11
F ratio	NS	*	*	*	*	*	*	NS
C.D. (P=0.05)	---	0.040	0.031	1.021	1.008	0.042	0.063	---

All values are average of three trials * indicate significance of value at P=0.05 NS=Non-significant

Table 4: Effect of replacement of green gram protein with whey protein concentrate on sensory attributes of weaning food

Level of substitution (%)	Sensory attributes (Max. score: 9.00)			
	Colour	Flavour	Consistency	Overall acceptability
Control	7.91	8.04	8.00	7.95
10	8.10	7.75	8.10	8.11
20	8.22	7.63	8.18	8.24
30	8.35	7.25	8.30	8.35
40	7.25	5.95	7.10	7.08
C.D. (P=0.05)	0.110	0.620	0.050	0.091

All values are average of three trials

with malted green gram, sugar, oil and other ingredients. Further in the experimental samples the green gram protein used in weaning food was replaced with whey protein concentrate (70 % protein) at 10 to 40 per cent. The effects of replacement of green gram protein with WPC on various chemical and sensory characteristics were studied. The results are presented in Tables 3 and 4, respectively. With the increasing in the level of substitution of green gram protein with WPC protein had no significant effect on moisture content of the weaning food. Moisture content varied between 4.59 and 4.49 per cent. The acidity of weaning food slightly increased with increase in the level of substitution from 0 to 40 per cent. The fat content of the control sample was 8.55 whereas it was 8.61, 8.70, 8.82 and 8.91 per cent at 10, 20, 30 and 40 per cent level of substitution. From the results it is evident that increased level of substitution led to increased protein content of formulated weaning food depicting that increased level of substitution has significant effect in proportionately increasing the protein content of weaning food.

It is observed that substitution of green gram protein with WPC significantly decreases carbohydrate content of weaning food. The carbohydrate content of control sample was 71.61 per cent, whereas it decreased to 70.69, 69.23, 67.62 and 66.15 after substituting the green gram protein with WPC at 10, 20, 30 and 40 per cent. The ash content of the weaning food varied between 1.77 and 2.37 per cent in the experimental sample whereas it was 1.50 per cent for the control sample. Increased level of substitution led to significant increase in the ash content of the formulated weaning food. Substitution of green gram protein with WPC was found to have significant effect on the crude fibre content of the weaning food. A significant decrease in the crude fibre content was observed with increase in the level of substitution. The crude fibre content was 1.37, 1.28, 1.19 and 1.09 per cent at 10, 20, 30 and 40 per cent level of substitution as against the control (1.48 %). The extent of replacement of green gram protein with WPC had no significant effect on the energy density of the weaning food. The energy density of control sample was 418.27 k cal/100g whereas for experimental sample it varied between 417.61 and 417.11 k cal/100g.

The effect of substitution of green gram with WPC on various sensory attributes of weaning food is presented in Table 4. As could be observed from the results with increasing in the level of WPC there was significant improvement in color and appearance of the product upto a level of 30 per cent replacement. Further increase to 40 per cent level decreased the score with respect to colour and appearance attribute.

The scores with respect to the colour attributes were increased with the increased level of substitution upto 30 per cent and had no significant effect in decreasing flavour scores though the score were slightly lesser as compared to control. However, above 30 per cent level, there was significant decrease in the scores awarded to the flavour attribute. The flavour score for the control sample was 8.04 whereas it was 7.25 for 30 per cent level of substitution. It is evident from the result that, consistency improves upon substitution of green gram with WPC upto 30 per cent level, thereafter, the scores for consistency attribute decreased. The scores awarded for over all acceptability attributes followed similar pattern as that of colour and consistency attributes. Substitution of green gram protein with WPC had significant effect on overall acceptability attribute upto 30 per cent. However, above 30 per cent level scores significantly decreased with respect to overall acceptability attribute. From the study it was concluded that the best quality weaning food could be prepared with the blend containing the blend of wheat and Ragi at the ratio of 50:50 and with the green gram substitution with WPC upto 30 per cent level without affecting the acceptability of the weaning food.

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LITERATURE CITED.....

Acharya, M.R. and Shah, R.K. (1998). Infant and weaning food formulations containing probiotic cultures. *Indian Food Industry*, **17** (6): 348-356.

Alexander, C. Mosha (1983). Preparation of weaning foods with high nutrient density using flour of germinating cereals. *Food & Nutr. Bull.*, **5** (2): 10-14.

AOAC (1980). *Official methods of analysis* 13th Ed., Association of Official Agricultural Chemist, Washington, D.C., 20044.

AOAC (1984). *Official methods of analysis* 13th Ed. Washington, D.C.

Macrae, R., Robinson, R.K. and Sadler, M.J. (1993). Encyclopedia of food sciences, *Food Technol. & Nutr., Pub. Academic Press Inc., London*, **4** : 2511-2515.

Makhal, S., Tannweer, A. and Sharma, D.K. (2003). Requirements and recent developments in weaning food. *Beverage & Food World*, **2** : 15-22.

Malleshi, N.G. (1995). Weaning food, RESC Scientific Series No. **8**, CFTRI, pp. 1-40.

Pawar, P.A. and Dhanvijay, V.P. (2007). Weaning food an overview. *Bverage & Food World November*, 2007.

Sajilata, G., Singhal, Rekha, S. and Kulkarni, P.R. (2002). Weaning foods: A review of the Indian experience. *Food & Nutr. Bull.*, **23** (2): 208.

Swamy, K. (2003). Development of malted weaning food by utilizing whey protein concentrates, M.Sc. Thesis, University of Agricultural Sciences, Bangalore, Karnataka (India).

Taragopal, Farhat Inamdar and Patel, Jayaprabha (1982). Malted verse roasted young dried mixes, viscosity, storage and acceptability trials. *Indian J. Nutr. Dietet*., **19** (1) : 37.

Tripathy, S.D., Vijayalakshmi and Jayaprakasha, H.M. (2003). Utilization of whey protein concentrate in Ragi (*Eleusine coracona*) based food products. *J. Food Sci. Technol.*, **40** (2):1-5.

Weaver, L.T. (1994). Feeding the weanling in the developing world, problems and solutions. *Int J. Food Sci. Nutr*., **45**: 127-134.