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In-vitro protein digestibility, mineral and vitamin content of wheat based weaning mixes

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Abstract

Nine different weaning foods were formulated using locally available cereals and pulses such as wheat (*Triticum aestivum*), green gram (*Vigna radiate*), bengal gram (*Cicer arietinum*), amaranth (*Amaranthus* sp.), skim milk and jaggery. Domestic processing technique like roasting and popping were used to process cereals and pulses for development of weaning foods. Different proportions of powdered ingredients were used to formulate the weaning foods by keeping wheat as base ingredient. The developed weaning foods had 69.73 to 435.88 mg calcium, 255.74 to 440.25 mg phosphorus, 4.53 to 6.98 mg iron, 49.05 to 77.88 µg carotene, 0.27 to 2.84 mg thiamine, 0.09 to 0.42 mg riboflavin, 2.30 to 3.12 mg niacin per 100g and 41.59 to 74.50 per cent protein digestibility. Nutrient composition of the developed weaning mixes was within the range recommended for infant weaning foods.

Key words: Weaning, infants and protein digestibility.

Introduction

Under-nutrition is one of the major problems confronting infants and young children in developing countries. Death and morbidity due to protein energy malnutrition in infancy continue to scourge population in many parts of the world .Breast feeding continues to be the mainstay in infant feeding in most parts of India. For the survival, health and development of infants, breast feeding should be protected and encouraged and supplementary feeding should be started at the age of four to six months (Sharma and Sharma, 2003). Cereals and pulses constitute an important source of dietary calories and protein for many of the world's population, especially in developing countries. The solution of the problem of malnutrition in our country fortunately does not call for expensive protein concentrates or other factory processed foods. There is a need, therefore, to develop weaning foods from the locally available resources which are economical, easily digestible and culturally acceptable in consonance with the traditional feeding practices and even be produced at the household or community levels. The weaning process allows the infants to discover new tastes and textures, and to experience different types of foods (Minhas, 2006). Therefore, the present study was undertaken to formulate weaning foods from locally available cereals and pulses and to evaluate the products in terms of *in vitro* protein digestibility, mineral and vitamin contents.

Material and Methods

Procurement and preparation of material: Amaranth grains were procured from the Department of Plant Physiology, HPKV, Palampur while wheat flour, green gram, roasted bengal gram, skim milk powder and jaggery were procured from the local market. Wheat flour was sieved and roasted in a cauldron (*karahi*) till light brown in colour. Green gram grains were cleaned manually and was roasted and milled in the willy mill. Roasted bengal gram were ground to a fine powder. Amaranth seeds were cleaned manually and dried in the sun. The popping of amaranth samples was achieved by heating the grains on a preheated cauldron to a temperature of 220^0 C till all grains were properly popped. The pooped grains were allowed to cool and then ground to a fine powder. The ground samples of all the ingredients were stored in airtight containers for further use.

Preparation of weaning foods: The different wheat based formulations were selected in such a way that each weaning food could provide 300 Kcal, 6- 9g protein and 6 -9mg iron per 100g per day.

Chemical analysis: The mineral content was estimated by the method given by Piper (1966). The vitamin content was calculated using food composition tables (Gopalan et al., 1996). In vitro protein digestibility was determined according to the method of Akeson and Stachmann (1964) and as modified by Singh and Jambunathan (1981). The data generated was subjected to analysis of

variance test following completely randomized design (Gomez and Gomez, 1984).

Results and Discussion

1) *In-vitro* protein digestibility: In-vitro protein digestibility of developed weaning foods ranged from 41.59 to 74.50 per cent (Table 2). Weaning mixes incorporated with green gram flour (Product code No. 2, 3, 5 and 7) had better digestibility as compared to the mixes having Bengal gram flour (Product code No. 1, 4, 6, 8 and 9). The relatively low digestibility of the raw weaning foods may be attributed to the reason that globulins which make up the larger protein of legume seed protein are resistant to denaturation and in the native state are not broken down by the digestive enzyme (Walker and Kochar, 1983). The increase in protein digestibility may be due to destruction of trypsin inhibitor and by opening of protein structure through denaturation. Heat treatments of proteineous foods result in the destruction of the protein which explains the improvement in their protein digestibility (Boonvisut and Whitaker, 1976). Ashturkar (1992) also reported almost similar values (53.48 to 86.07 %) for *in-vitro* protein digestibility for weaning mixes incorporating jowar, bajra, *rajkeera*, green gram, bengal gram dhal, soybean and rice flakes. Roasting and popping reduces moisture content and the heat treatment leads to inactivation of enzymes, thus increasing the shelf- life of the product. A higher value for in-vitro protein digestibility (80.22 to 84.43) was reported by Gupta and Sehgal (1991). An increase in protein digestibility after heat treatment to bengal gram, maize and soybean has been reported (Srivastav *et al.*, 1990).

Table 1. Different formulations for wheat based weaning mixes

Product Code	Ingredients	Quantity (grams)	Energy (Kcal)	Protein (g)
1	Roasted wheat	45	339.02	12.11
	Roasted Bengal gram	25		
	Jaggery	30		
2	Roasted wheat	40	326.98	14.76
	Roasted green gram	20		
	Skim milk powder	15		
	Jaggery	25		
3	Roasted wheat	35	333.34	13.37
	Roasted green gram	20		
	Amaranth	10		
	Skim milk powder	10		
	Jaggery	25		
4	Roasted wheat	35	333.98	14.09
	Roasted Bengal gram	20		
	Amaranth	10		
	Skim milk powder	10		
	Jaggery	25		
5	Roasted wheat	38	333.14	13.17
	Roasted green gram	22		
	Amaranth	15		
	Jaggery	25		
6	Roasted wheat	38	343.66	12.39
	Roasted Bengal gram	22		
	Amaranth	15		
	Jaggery	25		
7	Roasted wheat	40	344.03	14.71
	Roasted green gram	25		
	Amaranth	20		
	Jaggery	15		
8	Roasted wheat	40	355.84	13.82
	Roasted Bengal gram	25		
	Amaranth	20		
	Jaggery	15		
9	Roasted wheat	20	343.92	15.43
	Roasted Bengal gram	20		
	Amaranth	25		
	Skim milk powder	20		
	Jaggery	15		

2) Mineral content: The developed weaning foods had 69.73 to 435.88 mg calcium, 255.74 to 440.25 mg phosphorus and 4.53 to 6.98 mg iron per 100g (Table 3).The calcium and phosphorus content was maximum in weaning mix containing wheat flour, bengal gram, amaranth, skim milk powder and jaggery. All these values are with in the range of minimum requirement for calcium (230 mg/100g), phosphorus (115 mg/100g) and iron (5.0 mg/100g) for infants weaning foods as recommended by Anonymous (1997).

3) Vitamin content: Table 4 shows that the developed weaning foods had 49.05 to 77.88 µg carotene, 0.27 to 2.84 mg thiamine, 0.09 to 0.42 mg riboflavin and 2.30 to 3.12 mg niacin per 100 g. The maximum content of carotene was observed in product No. 1 and thiamin content was maximum in product No. 5 both containing green gram flour whereas maximum content of riboflavin was observed in product No. 9 and that of niacin in product No. 8 both the mixes having bengal gram flour.

Table 2. ***In-vitro*** **protein digestibility of different weaning mixes**

Product Code	Protein digestibility (%)
1	63.77
2	74.50
3	58.34
4	41.59
5	63.41
6	70.56
7	54.14
8	63.87
9	42.64
CD (P=0.05)	0.36

Table 3. Mineral content of different weaning mixes (mg/100 g)

Product Code	Calcium	Phosphorus	Iron
1	69.73	255.74	5.25
2	269.31	361.20	5.02
3	237.27	340.65	5.53
4	174.40	338.15	4.53
5	152.02	264.17	5.15
6	138.50	277.25	6.26
7	166.20	306.90	5.66
8	150.70	310.40	6.98
9	435.88	440.25	6.32
CD (P=0.05)	50.78	2.97	0.23

Table 4. Vitamin content of different weaning mixes (per 100 g)

Product Code	Carotene (µg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)
1	91.72	0.28	0.09	2.44
2	63.40	0.36	0.37	2.48
3	74.78	0.28	0.25	2.35
4	61.96	0.33	0.30	2.57
5	63.84	2.84	0.15	2.82
6	77.88	2.78	0.10	2.59
7	49.05	0.35	0.17	3.12
8	65.04	0.28	0.11	2.85
9	53.60	0.27	0.42	2.30
CD (P=0.05)	0.20	0.06	0.05	0.68

Source: Gopalan *et al.* (1996)

Conclusion

It can be concluded from the above study that the developed weaning foods containing bengal gram have higher percentage of calcium, phosphorous, iron and riboflavin whereas the invitro digestibility was higher in mix having green gram. Hence, these developed weaning products contain good nutritive value and can be suited well for the infants.

References

Akeson WR and Stachmann MA 1964. A pepsin-pancreatin digest index of protein quality evaluation. J. Nutr. **83**: 257

Anonymous 1997. Indian Standards Infant Milk substitutes-specification, New Delhi.Bureau of Indian Standards IS:14433 (I).

Ashturkar PB, Reddy S and Pande V 1992. Development and evaluation of weaning food formulations. J. Food. Sci. Technol. **29** (3): 197-198.

Boonvisut S and Whitaker JR 1976. Effect of heat amylases and disulfide bond cleavage on the in vitro digestibility of soybean protein. J. Agric. Food Chem. **2**: 1130.

Gomez KA and Gomez AA 1984. *Statistical Procedures for Agricultural Research.* 2nd Ed. New York, Willy, XVI.

Gopalan C, Rama Sastri BV and Balasubramanian SC 1996. *Nutritive value of Indian Foods.* National Institute of Nutrition, Hyderabad.

Gupta C and Sehgal S 1991. Development, acceptability and nutritional value of weaning mixtures. Plant Foods Human Nutr. 41: 107-116.

Minhas S 2006. Utilization of whey protein for the development of value added health foods. M Sc Thesis, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur (unpublished).

Piper CS 1966. Methods for the ashing of plant materials (chapter II).In: *Soil and Plant Analysis*, Hans Publishers, Nicol Road, Bombay, pp 258-75.

Sharma M and Sharma S 2003. Infant feeding practices in rural women of Kangra district of H.P. Him. J. Agric. Res. **29** (1&2): 79-83.

Singh U and Jambunathan R 1981. The levels of protease inhibitors, polyphenolic components and *in vitro* protein digestibility of desi and kabuli chickpeas. J. Food Sci. **46**: 1364-67.

Srivastav RP, Das H and Prasad S 1990. Effect of roasting process variables on in vitro protein digestibility of Bengal gram, maize and soybean. Food Chem. **35**: 31-37.

Walker AF and Kochar N 1983. Effect of processing including domestic cooking on nutritional quality of legumes. Proc. Nutr. Soci. **24**: 41-48.

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