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Nutritional evaluation of rice based weaning mixes

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Abstract

Three different varieties / accessions of amaranth viz., Annapurna,,EC-321561 and EC-321562 were evaluated for physico-chemical characteristics. The protein content was 10.74, 12.65 and 13.32 per cent. Annapurna variety of amaranth seeds was selected for the purpose of supplementation in different weaning mixes. Nine different weaning mixes were formulated using locally available cereals and pulses as rice (*Oryza sativa*) green gram (*Vigna radiata*), Bengal gram (*Cicer arietinum*), Amaranth (*Amaranthus* sp.), Skim milk powder and jaggery. Domestic processing techniques like roasting and popping were used to process cereals and pulses for development of weaning mixes .The developed weaning foods contained 9.37 to 14.19g protein, 1.17 to 4.93 g fat, 1.81 to 2.19g ash, 1.76 to 4.71g crude fiber and 321 to 350 Kcal of energy per 100g .Nutrient composition of the developed weaning mixes was within the range prescribed by Indian Standard Institute and was found to be acceptable. Being good sources of protein and energy can prove to be useful for infants especially suffering from protein energy malnutrition.

Key words: Weaning, amaranth seeds, nutrients.

Introduction

Under-nutrition is one of the major problems confronting infants and young children in developing countries. Infancy is considered to be the critical period during which there is a high incidence of mortality and morbidity. Breast milk contains most of the nutrients in appropriate proportions required to maintain growth upto six months of age. Subsequently, supplementary feeding has to be adopted to maintain the needs for growth requirement (Devdas *et al.* 1984).

Weaning is a transition period in which solid and table foods replace milk, such a shift involves not only a change in the texture but also the nutrient constituents in the diet of an infant (Mettler, 1982). Weaning that begins too early involves the risk of infection, whereas that beginning too late leaves the infant with an inadequate intake of nutrients and, thus, is harmful for growth and development.

Cereals and pulses constitute an important source of dietary calories and proteins for much of the world's population, especially in developing countries. Besides being good sources of protein and energy, serve as good source of minerals in the human diet. Cereals are considered "unbalanced" in terms of amino acids composition generally lacking in sufficient amount of lysine needed for optimum health. Amaranth protein, however, has nearly twice the lysine content of wheat protein, three times that of maize and in fact as much as is found in milk-the FAO standard of nutritional excellence. It is, therefore, a nutritional complement to conventional cereals (NAC, 1984). Amaranth seeds also serve as good sources of vitamins and minerals and contain a highly digestible starch (Singhal and Kulkarni, 1988). An attempt has therefore, been made to develop rice based weaning mixes using some of the locally available foods with the objectives ot standardize the preparation of rice based weaning mixes and to analyse the proximate composition of the prepared mixes.

Material and Methods

Procurement of material: Amaranth grains of three different varieties of amaranth "Annapurna", "EC-321561" and EC-321562" were procured from the Department of Plant Physiology, CSK HPKV, Palampur.

Preparation of cereals, pulses and amaranth seeds

i) Rice flour: Rice flour was roasted in a cauldron (Karahi) till light brown in colour.
ii) Green gram: Green gram was purchased from the local market. The grains were cleaned manually, roasted and milled in the willy mill.

iii) Bengal gram: Roasted bengal gram was purchased from local market and was ground to a fine powder.

iv) Amaranth seeds: The grains were cleaned manually and dried in the sun light. The popping of amaranth grain samples was done by heating amaranth grains on a preheated cauldron upto desired temperature i.e. 220 °C. When the treatment was completed, the product was removed, allowed to cool and then ground to a fine powder. The ground samples were stored in airtight containers for further use.

Preparation of weaning foods: The following foods were developed:

1. Roasted rice (45g); Roasted bengal gram (25g); Jaggery (30g).
2. Roasted rice (40g); Roasted green grain (20g); skim milk powder (15g); Jaggery (25g)
3. Roasted rice (35g); Roasted bengal gram (20g); Amaranth (10g); Skim milk powder (10g); Jaggery (25g).
4. Roasted rice (35g); Roasted green gram (20g); Amaranth (10g); Skim milk powder (10g); Jaggery (25g).
5. Roasted rice (38g); Roasted bengal gram (22g); Amaranth (15g); Jaggery (25g).
6. Roasted rice (38g); Roasted green gram (22g); Amaranth (15g); Jaggery (25g)
7. Roasted rice (40g); Roasted green gram (25g); Amaranth (20g); Jaggery (15g)
8. Roasted rice (40g); Roasted bengal gram (25g); Amaranth (20g); Jaggery (15g)
9. Roasted rice (20g); Roasted bengal gram (20g); Amaranth (25g); skim milk powder (20g); Jaggery (15g).

The above 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.

According to Indian Standard Infant Milk Substitutes Specifications IS-14433 (Part-I), 1997 the product should be white or white with a greenish tinge to light cream in colour reasonably free from lumps and should be uniform in appearance.

Chemical analysis: Three raw and popped amaranth varieties were analyzed for their physico-chemical properties by the method of Narain *et al.* (1978). The proximate composition of the prepared weaning mixes was determined by the method of AOAC (1990).

Results and Discussion

1. *Physico-chemical characteristics*: Effect of popping on the physical characteristics of "Annapurna", "EC-321561"and "EC-321562" varieties of amaranth seeds is presented in Table 1. The 1000 kernel weight of EC-321561 (0.625g) and Annapurna (0.700g). However, on popping of seed there was a significant increase in 1000 kernel weight of the samples. There was a maximum increase in 1000 kernel weight in case of "EC-321562". The values of treated and untreated samples were in close agreement with those reported by Bressani *et al.*, (1987).

Table 1. Physical characteristics of different Amaranth varieties/accessions

Varieties/accessions	1000-kernel weight (g)	Bulk density (g/ml)
Annapurna		
Raw	0.700	0.847
Popped	0.752	0.292
CD (P=0.05)	0.016	0.015
EC-321561		
Raw	0.625	0.897
Popped	0.705	0.185
CD (P=0.05)	0.013	0.013
EC-321562		
Raw	0.507	0.912
Popped	0.702	0.305
CD (P=0.05)	0.023	0.022

The bulk density reported as mass per unit volume was also determined. It was found to be lower in "Annapurna" (0.912g/ml) indicating that the grains of "Annapurna" were lighter than those of "EC-321561" and "EC-321562". There was a significant reduction in the bulk densities upon popping. The bulk density of EC-321562 decreased from 0.897 g/ml observed densities of popped samples of amaranth may be attributed to the volume expansion during popping. The increase in volume after popping amaranth was also reported by Erwin (1934) and Saunders and Beckar (1984) after popping.

The moisture content in case of raw samples was maximum in EC-321562 followed by Annapurna and EC-321561 whereas in case of popped samples the Annapurna had 7.69 per cent moisture followed by EC-321561 (6.46%) and EC-321562 (5.26%). There was a significant increase in protein values after popping, maximum in case of EC-321561 (15.26g) followed by EC-321562 (14.58g) and Annapurna (13.18g) per 100g (Table

2). Similar values for crude protein (11.8-17.6 %) were reported by Bressani *et al.* (1987). Upon popping, there was an increase in the fat and ash contents. The values of crude fibre varied from 4.99g to 10.10g/100g and in case of popped 9.30g to 13.50g/100g. Almost similar values of crude fibre (4.93 to 12.80 %) were observed by Singhal and Kulkarni (1988). The carbohydrate content decreased after popping and similar results were reported by Saunders and Becker (1984).

Table 2. Proximate composition of different amaranth varieties/accessions

Varieties/accession	Moisture	Crude protein	Crude fat	Total ash	Crude fibre	Carbohydrates
Annapurna						
Raw	13.57	10.75	7.10	1.83	4.99	61.76
Popped	7.69	13.18	8.46	2.60	9.30	59.77
CD(P=0.05)	0.69	0.45	NS	0.19	0.30	0.31
EC-321561						
Raw	13.05	12.65	6.06	2.48	10.10	55.66
Popped	6.46	15.26	9.76	3.24	10.69	54.14
CD (P=0.05)	0.56	0.37	0.19	0.15	0.24	
EC-321562						
Raw	13.64	13.32	6.80	2.41	5.68	58.15
Popped	5.26	14.58	8.95	3.91	13.50	53.80
CD (P=0.05)	0.98	0.64	0.34	0.27	0.42	0.45

Values expressed as per cent

2. *Energy value of weaning mixes*: Jaggery was added in order to increase the energy value of weaning foods whereas skim milk powder was also added in order to improve the protein content. Therefore, weaning foods using locally available cereals, pulses and jaggery were developed. The energy values of different weaning foods have been presented in Table 3. The energy value of mixes ranged from 321 to 350 Kcal/100g. The minimum energy contribution was found in the mix containing rice, green gram, skim milk powder and jaggery. The maximum energy value was found in the mix prepared from rice, bengal gram, amaranth and jaggery. Gahlawat and Sehgal (1974) reported the calorie content of weaning foods ranging from 348-364 Kcal/100g.

3. *Proximate composition*: The proximate composition of weaning foods are presented in Table 4. The nutritional value of the weaning foods ranged as follows:

Moisture, 11.93-16.75; protein, 9.37-14.19g; fat, 1.17 – 4.93g; ash, 1.81-2.19g; crude fibre, 1.76-4.71g and carbohydrates, 61.10- 69.16g per 100g. The maximum values of protein (14.19g/100g) and fat (4.93g/100g) were observed in weaning mix consisting of rice, bengal gram, amaranth, skim milk powder and jaggery. Whereas, the maximum carbohydrate content (69.16g/100g) was observed in weaning mix consisting of rice, bengal gram and jaggery. Almost similar value for protein (9.84 to 9.95g) was reported by Gupta and Sehgal (1991). As reported by Pawar *et al.* (1994) a range of 3.3 to 3.7g per cent for fat in weaning foods was observed similar to that of present findings.

Conclusion

The weaning foods in the present study were based on commonly consumed, inexpensive locally available food stuffs which involve no additional economic burden because they were already available in the home. Being inexpensive, easily available and nutritious, these formulations could be effective in ameliorating the common symptoms associated with the incidence of protein energy malnutrition.

Table 3. Energy values of developed weaning mixes

Mix no.	Ingredients	Quantity (g)	Energy (Kcal)
1.	Rice	45	332
	Bengal gram	25	
	Jaggery	30	
2.	Rice	40	321
	Green gram	20	
	Skim milk powder	15	

	Jaggery	25	
3.	Rice	35	332
	Green gram	20	
	Amaranth	10	
	Skim milk powder	10	
	Jaggery	25	
4.	Rice	35	324
	Bengal gram	20	
	Amaranth	10	
	Skim milk powder	10	
	Jaggery	25	
5.	Rice	38	338
	Bengal gram	22	
	Amaranth	15	
	Jaggery	25	
6.	Rice	38	327
	Green gram	22	
	Amaranth	15	
	Jaggery	25	
7.	Rice	40	338
	Green gram	25	
	Amaranth	20	
	Jaggery	15	
8.	Rice	40	350
	Bengal gram	25	
	Amaranth	20	
	Jaggery	15	
9.	Rice	20	345
	Bengal gram	20	
	Amaranth	25	
	Skim milk powder	20	
	Jaggery	15	

Table 4. Proximate composition of weaning mixes

Product	Moisture	Crude protein	Crude fat	Total ash	Crude fibre	Carbohydrates
1	18.78	9.37	2.03	1.86	1.76	69.16
2	16.75	12.31	1.17	1.81	2.66	65.27
3	15.78	11.22	2.63	2.03	2.42	65.93
4	15.90	11.92	1.91	1.82	3.49	64.86
5	14.42	10.02	3.03	1.97	2.93	67.59
6	14.65	10.83	2.24	2.19	4.12	65.97
7	12.19	12.25	2.78	2.09	4.71	66.02
8	11.93	11.37	3.68	1.85	3.39	67.79
9	14.47	14.19	4.93	1.85	3.54	61.10

Values expressed as g/100g

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