RESEARCH ARTICLE — FOOD SCIENCE RESEARCH JOURNAL — Volume 3 | Issue 2 | October, 2012| 232-235

Enhancing nutritional quality of extruded product by incorporating an indiginous composit powder

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Nutrition and diet are important factors in combating deficiency diseases among children. The incidents of protein energy malnutrition and micro-nutrient deficiencies especially vitamin A and iron are common among under five aged children in India. There is a strong thrust to develop such snacks which not only provide maximum nutrient but also must be liked by this group. Extruded products are most popular in children. In present study an effort has been made to develop a ready to cook extruded product using an indigenous composite powder rich in micronutrients. This composite powder named "Udaipur ACRIP Mix" was developed by Foods and Nutrition unit of AICRP on Homes Science and is rich in vitamin A and iron. This powder was prepared from dried carrot, spinach, mint, lotus stem, rice flacks, and niger seeds. The reference extruded product was prepared with wheat, bengal gram and maize flour in the ratio of 30, 25 and 45 per cent, respectively. Whereas in experimental products, Udaipur AICRP Mix (UAM) powder was added in different ratio *i.e.* 5, 10, 15 and 20 per cent with the replacement of maize flour. Addition of UAM up to 10 per cent in raw material was found most acceptable at nine point hedonic rating scale. The mean scores for organoleptic characteristics of sweet and savory snack developed with composite flour ranged from 7.8 to 8.7 at nine point hedonic rating scale. The control and experimental product were analyzed for their proximate and iron composition by the standard method. Results revealed that the protein, fat, energy and iron content for reference was 12.25g, 1.45g, 381 kcal and 4.58 mg, respectively. While with addition of UAM 10 per cent, contain protein 15.31g, fat 4.0g, energy 410 kcal and iron 11.68 mg. The extruded product stored for three month for its shelf life evaluation and showed no significant difference in organoleptic quality during the storage of product.

Key Words : Extruded, Cold extrusion, Composite powder, Sweet snack, Savory snack, Micronutrient, Iron rich mix

How to cite this article : Jain, Shashi, Patni, Dheera and Bhati, Dashrath (2012). Enhancing nutritional quality of extruded product by incorporating an indiginous composit powder. *Food Sci. Res. J.,* **3**(2): 232-235.

INTRODUCTION

Snack foods now comprise an important part of the daily nutrient and calorie intake especially for children. Extrusion cooking is used extensively in the manufacture of ready to cook and eat snacks/ breakfast cereals and has dramatically transformed the cereal industry, the key being quality extruded products offered to consumers at competitive price (Lin *et al.,* 2002). Convenience food usually titled as junk foods, empty energy foods etc. Food industries thus making all the efforts to enrich their foods with various nutrients to deny this label.

Drying of vegetables and fruits during season and their use in off season is a traditional practice. Most of the vegetables are seasonal, but their demands retained throughout the year. Preservation of fresh vegetables at homestead level is quite expensive and less feasible. Drying is the traditional and most convenient practice to increase the longevity of products. This is a common practice which has been used since ancient India. A micronutrient rich (vitamin A and iron) powder has been developed under All India Coordinated Research Project on Home Science, Foods and Nutrition Udaipur. This indigenous powder mix named "Udaipur AICRP Mix"(UAM) contains - carrot, lotus stem, rice flakes, niger seeds, spinach and mint powder in the ratio of 1:9:3:4:2:1, respectively (AICRP, 2001 and Jain *et al.*, 2010).

In India although mid day meal schemes have been introduced in schools where fortification of food such as iodized salt is served to promote growth and development in children

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but micronutrients such as vitamin A, iron and other minerals are also essential to prevent childhood malnutrition. An attempt was made in present investigation to develop a nutritious product through extrusion by incorporating UAM to enrich its nutritional content specifically the iron.

METHODOLOGY

Preparation of flour mix:

Cereal flour shows a better compatibility in extrusion technology. In the present investigation, the combination of cereal and pulse was used for the preparation of extruded product. Maize, wheat and bengal gram were procured from local market and cleaned for natural impurities such as stone, grass, agricultural waste materials etc. These were then milled to obtained flour. The reference extruded product was prepared with maize flour, wheat and bengal gram in the ratio of 45, 30 and 25 per cent, respectively. For development of micronutrient rich extruded product, composite mix (UAM) was used in 5, 10, 15 and 20 per cent by replacing maize flour. UAM was procured from AICRP, Home Science, Foods and Nutrition Department, MPUAT, Udaipur.

Product development:

Extruded products were developed using cold extruder machine (Pasta machine, ANNA-A45). Extrusion is the act or process of shaping material by pushing or forcing through a die. A die is a device for cutting out, forming or stamping material. Material comes in different shapes, size and type depending on the use of the finished product. In present investigation the curl die was used to prepare the product. After manual mixing of various flours it was fed to the machine.

Organoleptic evaluation of product: -

After development of experimental and reference products they were subjected for sensory evaluation using the standardized recipe of sweet and savory snacks. The sensory characteristics, such as appearance, colour, flavour, texture, taste and overall acceptability were evaluated by panel members at nine point hedonic rating scale (Swaminathan, 1987). To improve the textural quality of product it was wrapped in 17"× 12"sized towel which was moistened by sprinkling 50 ml water before the cooking. For the preparation of sweet snack, 15g of sugar was taken in medium size pan and 150ml of water was added. It was allowed to boil till it become a two thread syrup. Then the product was fried in hot oil for 1 minute. The fried product was put into sugar syrup for 5 minutes. It was shacked properly so that sugar syrup coats the entire product uniformly. For the preparation of savory snack species were sprinkled after frying immediately so that it sticks with product, 5 ml of lemon juice was sprinkled to improve the taste.

Nutritional evaluation:

Both reference and experimental products were subjected for proximate composition *i.e.* moisture, total ash, fat, protein, fiber and carbohydrate using standard method (NIN, 2003). Analysis was done for raw mix and also the extruded snack product. Carbohydrate was estimated by difference method and energy was calculated using fuel value of protein, carbohydrates and fat. Iron was estimated by atomic absorption spectrophotometer. Whereas the most acceptable product was also nutritionally analyzed after cooking as sweet and savory snack.

Shelf life evaluation:

Most acceptable experimental product was subjected to shelf life evaluation for the period of three months. Reference and experimental extruded products were packed in a air tight jar and kept at room temperature. Organoleptic characteristics were evaluated with an interval of one month preparing sweet and savory snacks. Sensory evaluation was done at nine point hedonic rating scale by a group of 10 panel members.

OBSERVATIONS AND ASSESSMENT

The result of the present study have been discussed in detail as under:

Development of extruded products:

The reference extruded product was prepared adding wheat, bengal gram and maize flour (Table 1). In experimental product the UAM was added at 5, 10, 15 and 20 per cent level replacing maize flour detail of ingredients used are given in Table 1. The products were then cooked as sweet and savory snacks for the evaluation of their acceptability.

Organoleptic evaluation of developed extruded product:

Sensory evaluation of the extruded product was done by making sweet and savory snacks. It was observed that all the products with composite mix were scored above 6 (like slightly) for all the sensory traits. Whereas addition of composite mix

Table 1. Details of ingredients used to prepare extruded products

Ingredients	Amount				
	Control	UAM-200	UAM-150	UAM-100	UAM - 50
Wheat flour (g)	300	500	450	500	500
Bengal gram (g)	250	300	400	400	450
Maize flour (g)	450	-	-	-	-
Udaipur AICRP Mix powder (g)	-	200	150	100	50
Butter (g)	10	10	10	10	10
Curd (ml)	300	-	-	-	-
Water (ml)	-	180	180	180	180

Table 2. Acceptability scores of savory snack prepared from extruded products Mean ± SD (SE) (n=10)

Treatments	Colour	Taste	Texture	Flavour	Appearance	Overall acceptability
Reference	8.60±0.57 (0.05)	7.40±4.5 (0.04)	7.6±0.46 (0.04)	7.2±0.42 (0.04)	8.5±0.51 (0.05)	7.9±0.50 (0.05)
UAM 20 per cent	6.2±0.32 (0.03)	6.9±0.46 (0.04)	7.2±0.46 (0.04)	6.9±0.43 (0.04)	6.8±0.32 (0.03)	7.2±0.51 (0.05)
UAM 15 per cent	6.9±0.47 (0.04)	7.2±0.51 (0.05)	8.1±0.47 (0.04)	7.1±0.43 (0.04)	7.5±0.52 (0.05)	7.5±0.52 (0.05)
UAM10 per cent	7.1±0.51 (0.05)	8.6±0.57 (0.05)	8.1±0.47 (0.04)	7.4±0.47 (0.04)	7.5±0.52 (0.05)	8.1±0.49 (0.04)
UAM 5 per cent	7.3±0.44 (0.04)	8.9±0.57 (0.05)	8.1±0.47 (0.04)	7.5±0.49 (0.04)	7.5±0.52 (0.05)	8.3±0.53 (0.05)

(UAM) up to 10 per cent level scored better for acceptability than the higher ratio.

Savory snack:

Results shown in Table 2 reveals among savory snacks experimental products made from UAM 20 per cent was least liked by the panel member as compared to other experimental products and reference product. This was observed that the higher concentration of UAM in the extruded product results in bitter after taste may be due to the presence of dried vegetables in the UAM powder. Experimental products, UAM 10 and 5 per cent had scored highest for all the sensory attributes *i.e.* colour, taste, texture, flavour, appearance and overall acceptability.

Sweet snacks:

It is evident from Table 3 that the mean scores for the overall acceptability were 7.8 to 8.7 for sweet snacks prepared from reference and experimental extruded products. It was observed that with increasing the ratio of composite mix the colour of the product becoming darker and thus scored less.

A comparison of extruded and reference products showed that addition of indigenous powder mix up to 10 per cent level is almost equally acceptable on the reference. Higher to this reduces the acceptability, may be due to darker colour and change in taste. Thus, addition of powder up to 10 per cent was selected for further study. Mahesh *et al.* (2000) enrich the total six cereal pulse based food preparation with green leafy vegetables to combat anemia. All the preparations were extremely liked in all sensory attribute by the panel members.

The results clearly indicate that although sweet and savory snacks made from the reference and experimental extruded products were acceptable but the sweet snacks were comparatively liked to greater extent than that of savory snacks. There was no significant difference observed between acceptability scores of sweet and savory snacks of extruded products. It clearly shows that both the snacks were equally accepted.

Nutrient composition of extruded product:

Proximate composition and iron content was analysed at three levels *i.e.* ingredients mix, extruded products and after preparation of snacks for reference and experimental samples.

Snacks were prepared only from extruded powder having 10 per cent indigenous powder mix. The reference extruded product contain protein 12.25 g per cent, fat 1.45 g per cent and iron content was noted 4.58mg per 100g where as in the case of 10 per cent UAM extruded product contain protein 15.31 g per cent, fat 4 g per cent and iron content was observed 11.68. No significant difference was noted in the case of fiber (Table 4). Thus clearly shows that addition of UAM improved the nutritional quality of product.

Storage life:

Assurance of the product nutritional and physical quality and the package reliability under normal storage condition's accomplished by shelf life assessment. Storage study indicated no change in sensory characteristics of extruded products as obtained similar scores at 0 and after 3 months storage. The overall acceptability of the snacks was in the range between 8.2 to 8.5 this clearly indicated that both the snacks were like very much to extremely even after 3 months storage revealing that developed extruded product can be stored up to 3 months.

Table 3. Acceptability scores of sweet snack prepared from reference and experimental extruded products Mean ± SD (SE) (n=10)

Treatments	Colour	Taste	Texture	Flavour	Appearance	Overall acceptability
Reference	8.9±0.57 (0.05)	7.6±0.46 (0.04)	8.2±0.49 (0.04)	7.4±0.43 (0.04)	8.5±0.51 (0.05)	8.0±0.50 (0.05)
UAM 20 per cent	6.3±0.32 (0.03)	7.6±0.46 (0.04)	7.2±0.43 (0.04)	7.1±0.46 (0.04)	7.1±0.46 (0.04)	7.8±0.48 (0.04)
UAM 15 per cent	7.2±0.47 (0.04)	8.4±0.51 (0.05)	8.3±0.47 (0.04)	7.1±0.43 (0.04)	7.5±0.52 (0.05)	8.1±0.61 (0.06)
UAM10 per cent	7.9±0.51 (0.05)	8.9±0.57 (0.05)	8.5±0.51 (0.05)	8.5±0.47 (0.04)	7.5±0.52 (0.05)	8.7±0.46 (0.04)
UAM 5 per cent	8.0±0.49 (0.04)	8.9±0.57 (0.05)	8.5±0.51 (0.05)	8.6±0.47 (0.04)	7.5±0.52 (0.05)	8.7±0.46 (0.04)

Table 4. Nutritional composition of reference and experimental samples on dry weight /100g

Sr. No.	Detail	Moisture	Protein (g)	Fiber (g)	Fat (g)	Ash (g)	CHO (g)	Energy (Kcal)	Energy ratio	Iron (mg)
Raw mixes	Reference	7.12	14	0.05	2.8	1.5	81.65	408	80:6.1:13.7	6.96
	UAM 200	6.41	16.92	0.08	6.05	2.64	74.61	419	71.2:12.9:15.8	12.48
	UAM 150	8.56	12.25	0.07	4.7	2.52	80.46	413	77.9:10.2:11.8	10.56
	UAM 100	8.93	14	0.06	4.6	2.46	76	413	76.5:10.0:13.5	10.52
	Reference	4.63	12.25	0.05	1.45	1.98	79.63	381	83.6:3.4:12.8	4.58
	UAM 200	9.23	14.87	0.06	5.9	2.84	76.31	418	73.0:12.7:14.2	14.19
	UAM 150	11.27	14.87	0.06	5.8	2.72	76.54	418	73.2:12.4:14.2	13.12
Extruded product	UAM 100	10.58	15.31	0.05	4	2.42	78.21	410	76.3:8.7:14.9	11.68
Snacks	Sweet	2.91	10.5	0.08	11.7	7.1	70.63	430	65.7:24.4:9.7	10
	Savory	2.75	10.5	0.1	10.95	7.36	71.09	425	66.9:23.1:9.8	7.11

Conclusion:

The study concluded that a indigenous powder mix can be incorporated to prepare ready to cook type extruded products up to 10 per cent level to enhance their nutritional quality. It is suggested to use such products for mass feeding to improve nutritional status of target groups.

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Received: *26.07.2012;* **Revised:** *30.08.2012;* **Accepted:** *15.09.2012*