

Quality protein maize for nutritional security

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■ **ABSTRACT** : Food insecurity and hunger affect over 900 million people globally each year with the most at-risk populations living in poor, underdeveloped and developing nations. More than 200 million of the world's children are hungry and at least 5 million die each year from nutrient-deficiency diseases. Maize (*Zea mays*) is a major cereal crop for human nutrition worldwide with its high content of carbohydrates, fats, proteins, some of the important vitamins and minerals. Maize acquired a well deserved reputation as a poor man's nutria- cereal. However, in spite of several important uses, maize has an inbuilt drawback of being deficient in two essential amino acids, viz., lysine and tryptophan and the same has been overcome by developing quality protein maize (QPM) which contains twice the quantity of lysine and tryptophan, thus, making it rich in quality of protein in maize. With this background an attempt has been made to process the maize into local south Indian foods in which nutrients are more readily available and optimally utilized. Quality protein maize (QPM) was substituted with different proportions in traditional foods (Idli, Dosa, Pittu and Adai), convenience foods (Papad and Noodles), bakery foods (Cookies and Bread) and snack foods (Vada and pakoda) which were organoleptically evaluated using 9 point hedonic scale. The entire products were scored maximum acceptability. This contributes food and nutritional security by meeting energy and protein needs of consumer. Value added products prepared from maize can help in increasing food availability, adding variety to it and make the diet rich in micronutrients with affordable price and helps to eradicate hunger and poverty.

■ **KEY WORDS** : Maize, Quality protein maize, Lime treatment, Sensory evaluation

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Food insecurity and hunger affects over 900 million people globally each year with the most at-risk populations living in poor, underdeveloped and developing nations. More than 200 million of the world's children are hungry and at least 5 million die each year from nutrient-deficiency diseases. Cereals are the most important source of world's food and have significant impact in human diet. In India and Africa, cereal products comprise of 80 per cent or more of the average diet, 50 per cent in central and Western Europe and between 20-25 per cent in the US (Adebayo *et al.*, 2010). Maize (*Zea mays*) is a major cereal crop for human nutrition worldwide with its high content of carbohydrates, fats, proteins, some of the important vitamins and minerals. Maize acquired a well deserved reputation as a poor man's nutria- cereal. Maize, providing an estimated 15 per cent of the world's protein and 20 per cent of the world's calories, is a dietary staple for more than 200 million people.

This number can be expected to grow as the world's population approaches 8 billion in 2025 (Nuss and Tanumihardjo, 2010). However, in spite of several important uses, maize has an inbuilt drawback of being deficient in two essential amino acids, viz., lysine and tryptophan and the same has been overcome through an inter-disciplinary research involving breeders, biochemists and other disciplinary scientists, International Maize and Wheat Improvement Center (CIMMYT) researchers developed quality protein maize (QPM). This contains twice the quantity of lysine and tryptophan, thus making it rich in quality of protein in maize. Today more than 23 countries have released and are producing QPM in the developing world. Three decades of research at CIMMYT has led to the development of QPM cultivars that possess high- yield and better quality that can lead to nutritional security among developing world poor. Nutritional inadequacies of normal maize eliminate

by supplementation of protein rich sources *viz.*, pulses, milk and milk products and vegetables. In order to achieve the food and nutritional security of our country the current thrust is an effective utilization of QPM and its products in diversified way, by conversion into a variety of products for use as infant foods, health foods/ mixes, convenience foods speciality foods and emergency ration (Shobha *et al.*, 2011). Hence, the present study was undertaken to develop nutritious recipes based on QPM maize as flour and suji (semolina) by supplementing with pulses.

■ RESEARCH METHODS

Selection of products :

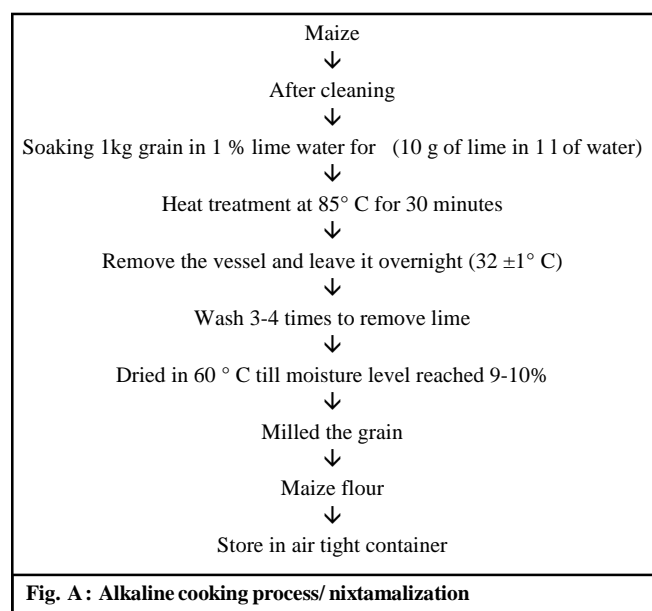
The present research was carried out in the Food Science and Nutrition department laboratory, Home Science College and Research Institute, Madurai. Quality protein maize (QPM) was substituted with different proportions in traditional foods *viz.*, idli, dosa, adai and pittu, in convenience foods as papad and noodles, in bakery foods as cookies and bread and snack foods like vada and pakoda.

Procurement :

Quality protein maize was bought from Zonal Agricultural Research Station (ZARS), Mandyal, Karnataka, India and other ingredients used for the study were bought from the local market.

Preparation of nixtamalized maize flour:

In order to increase the bioavailability of niacin from maize alkaline cooking process/ nixtamalization process carried out. The laboratory process for preparing dry maize flour according to Milan-Cartillo *et al.* (1996): The whole grains (1kg) were soaked in 1 per cent calcium hydroxide



solution (1:3w/w ratio) and then cooked for 30 min on stove at 85° C. The nixtamal was steeped over night (15 h) at 32±1° C, washing followed with excess (5l) tap water in three times. The grains were spread on tray and dried in a dryer (60°C) for about 6 h, dried until the moisture percentage reached to around 9-10 per cent with occasional mixing. The dried grain was ground in commercial milling unit and then sieved using 80 mm mesh. The flour prepared from grains were stored in an air tight container for further preparation (Fig. A).

Preparation of traditional foods:

Traditional foods are a rich heritage of India and offer wide diversity because of their origin in different regions and involvement of multidimensional culture. Development of traditional maize based foods, and utilization of maize in traditional recipes would increase diversify end products. For idli and dosa, rice was replaced with QPM maize. Black gram dhal (20 g), rice (25 g) and fenugreek (4 g) were soaked in water for 4 hour and maize (50 g) was soaked in water for 6 hours separately. All the ingredients were ground to a batter with water; allowed it for fermentation of 10-12 hours. Fermented batter was steamed as idli and poured on tawa and shallow fried as dosa. Adai was prepared using green gram (10 g), black gram (10 g), Bengal gram (10 g), horse gram (10 g), red gram (10 g) and rice (20 g) were soaked in water for 2 hours simultaneously maize (30 g) was soaked in water separately for 4 hours. Ingredients were ground in to a coarse batter with red chillies and allow it for fermentation for 4 hours. In the batter salt, chopped onion, asafoetida, curry leaves and coriander leaves were added. Pittu is another steamed breakfast item, wherein rice flour (25g), maize flour (75g) and salt (2 g) were mixed with water, steamed cooked in the idli cooker for 6-8 min and coconut scabbling and sugar were added before serving.

Preparation of convenience foods:

Extrusion cooking is one of the latest technologies used for the preparation of convenience food. Extruded products are mainly from wheat, as well as rice and from other sources. In order to meet the growing demand of population low cost maize flour was used in extrusion cooking. Equal amount of maize flour (50 g), maida (50 g) and salt together steamed for 15 min then the flour was cooled, broken the lumps and sieved again. Further the flour was filled in mixing compartment of pasta making machine and kneaded with water for 15 min and was extruded using noodle die. The extruded noodle was steamed for 5 minutes, dried in a cabinet drier at 60° C for 2 hours. The dried noodle was packed in the polyethylene bags for further use. Papad is a popular snack food in south India. It is also known as 'appalam' which is a thin wafer like circular product normally consumed as roasted or fried product. Maize flour (30g), black gram flour (70g), sodium bi carbonate (1g), cumin

seeds (1.2g), asafoetida (0.2g) and salt (5g) were kneaded with 50 ml of water. After allowing 30 min for dough development, the dough was divided into balls and rolled into thin circular discs using wooden rolling pin. The raw papad was dried in the sunlight for 2 hours, fried in oil for 10-15 sec ($190\pm 5^{\circ}\text{C}$) and evaluated for sensory attributes.

Preparation of bakery products:

The demand of bakery products is increasing at the rate of 10.07 per cent per annum. Baked products are considered as an excellent vehicle for fortification, value addition and feeding at mass scale. The cookies were prepared using 75 g of maize flour, 30 g sugar, each 25 g of maida, fat, 1/4 tsp of baking powder and vanilla essence (1 tsp). The cookies were baked at 170°C for 15 min in a preheated oven. Another bakery product of bread was prepared using refined wheat flour (80g), maize flour (20 g), sugar (18g), shortening (8g), salt (1.5 g) and yeast (1.5 g). Flour was mixed with the yeast suspension in water followed by sugar and salt solutions and made into dough. Shortening was added to it and kneaded again and the dough was proven for 2 hours at 40°C . The rested dough was kneaded, shaped into rectangular forms and placed in the bread pan for final proving for 30 minutes. The bread was baked at 220°C for 15 minutes, cooled and evaluated.

Preparation of snack food:

Snacks contribute to an important part of many consumers' daily nutrient and calorie intake. Consumers enjoy snack foods with good taste, flavour and pleasing textural mouth feel. The maize based snack food maize vada was prepared by the maize (75 g) in to grits in mixie and soaked in the water with bengal gram dhal (25 g) then ground as coarsely. Salt, chopped onion, green chillies, coriander leaves and curry leaves were added in the dough and made in to small balls; pressed with palm to a round shape. Then the vada was deep fried in warm oil till it turns into golden brown colour. Another one of the south Indian snack of maize

pakoda was prepared using maize flour (75 g), bengal gram flour (25 g) and rice flour (5 g). All the ingredients were mixed thoroughly with water and chopped onions, green chillies, curry and coriander leaves, salt were added and made into batter consistency. Then the dough was put in small pieces in the heated oil and deep fried till it turns to golden brown colour.

Organoleptic evaluation:

Panel of thirty judges consisting of faculty of Department of Food Science and Nutrition, Home Science College and Research Institute, Tamil Nadu Agricultural University, India evaluated the prepared products on the various parameters like colour, appearance, flavour, texture, taste and overall acceptability by using nine point hedonic scale (Srilakshmi, 2005).

RESEARCH FINDINGS AND DISCUSSION

The result of sensory evaluation of maize flour and maize suji based products are given in Table 1. In organoleptic evaluation of maize based recipes, first parameter to be evaluated was colour. In ten recipes, it ranged from 8.2 ± 0.42 to 8.7 ± 0.43 among the products adai was scored highest and all the products were light yellowish in colour due to the maize flour substitution. The scores for appearance ranged from, 7.6 ± 0.68 to 8.5 ± 0.46 . While cookies obtained lowest score of appearance due to the high amount of fat increase the brittleness of the cookies. Regarding the flavour the mean scores between 8.0 ± 0.37 to 8.6 ± 0.56 . There was a significant corn flavour was noticed in all the products. Texture can be defined as the combined feeling of tongue, palate and lips, and can be crunchy, granular, soggy, soft, sticky etc. As per the texture, the scores varied from 7.1 ± 0.64 to 8.6 ± 0.50 . Taste is the sensation perceived by the tongue which includes sweet, salty, sour and bitter sensations. The basic requirement for any food to be accepted is taste. The developed products were obtained the highest scores by the evaluators. The

Sr. No.	Products	Colour	Appearance	Flavour	Texture	Taste	Overall acceptability
1.	Idli	8.5 ± 0.68	8.3 ± 0.65	8.4 ± 0.49	8.4 ± 0.67	8.5 ± 0.50	8.5 ± 0.57
2.	Dosa	8.2 ± 0.53	8.5 ± 0.46	8.3 ± 0.65	8.5 ± 0.62	8.7 ± 0.46	8.6 ± 0.56
3.	Pittu	8.3 ± 0.44	8.1 ± 0.37	8.3 ± 0.54	8.5 ± 0.50	8.6 ± 0.46	8.3 ± 0.55
4.	Adai	8.7 ± 0.43	8.4 ± 0.67	8.6 ± 0.56	7.8 ± 0.54	8.2 ± 0.48	8.6 ± 0.56
5.	Papad	8.4 ± 0.49	8.5 ± 0.50	8.4 ± 0.49	8.2 ± 0.76	8.2 ± 0.76	8.3 ± 0.46
5.	Noodles	8.2 ± 0.44	8.4 ± 0.50	8.0 ± 0.37	8.3 ± 0.67	8.3 ± 0.69	8.2 ± 0.46
8.	Cookies	8.6 ± 0.49	7.6 ± 0.68	8.2 ± 0.40	7.1 ± 0.64	8.3 ± 0.43	8.1 ± 0.57
8.	Bread	8.2 ± 0.44	8.4 ± 0.50	8.1 ± 0.37	8.2 ± 0.67	8.2 ± 0.69	8.1 ± 0.34
6.	Vada	8.3 ± 0.43	8.4 ± 0.50	8.3 ± 0.49	8.6 ± 0.50	8.4 ± 0.57	8.6 ± 0.56
7.	Pakoda	8.2 ± 0.42	8.3 ± 0.57	8.4 ± 0.48	8.4 ± 0.52	$8.8.5\pm 0.51$	8.5 ± 0.57

Values are mean \pm S.D.

overall acceptability of a products depend on the weight, volume, size, moisture content, alcohol insoluble solid, fibre content, density, colour, acidity, sugar concentrations, pH, salt, volatile reducing substances, peroxides value etc (Singh and Devi, 2011). However, sensory evaluation revealed that highest score for overall acceptability of QPM were dosa, adai, vada (8.6 ± 0.56) and lowest score for cookies and bread (8.1 ± 0.34). Idli, dosa, pittu, adai are traditional products easily can prepare at household level and suitable for children and old age people. Vada, *Pakoda*, cookies are snacks gives high calorie and protein requirement than the commercially available snacks. Noodle is the value added recipe which can store longer period provides high protein and fibre to the consumer in the convenient forms. Priya and verma (2010) prepared gruel, *Methi Roti*, *Palak Poori*, pancake, mixed vegetables pakoda, namkeen para and tocos using maize flour as a main ingredients. The sensory evaluation revealed that highest score for overall acceptability of pan cake (8.6 ± 0.4) and lowest for *Methi Roti* (7.3 ± 0.64). Singh *et al.* (2011) prepared three traditional products *viz.*, *Mathi*, *Pakoda* and sev out of yellow maize (HM4) variety. Maize flour was incorporated with bengal gram flour of 20-60 per cent and organoleptically using nine point hedonic scales. The result showed that mathi prepared by replacing 80 per cent *Pakoda* and sev prepared by replacing 40 per cent of bengal gram flour with maize flour obtained the above 7 mean scores for over all acceptability. Divakar and Francis (2010) conducted the sensory evolution in seven varieties of rice. In this they prepared the eight dishes namely table rice, idiappam, pittu, appam, ada, pathiri, idli and dosa being the very popular dishes of keralites. The results showed that all the dishes had scored maximum and each variety was suited for different dishes.

Conclusion:

Maize, the third important cereal contains all the essential nutrients contributing food and nutritional security by meeting energy and protein needs of consumer. The study opens new areas of research since the product development can be scientifically tested and it will help in creating demand

by forming a base for commercial product development as a low cost nutritional snack which will have ready market in both rural and urban areas. The feasibility of using maize for preparation of different traditional and non traditional foods provides health benefits and also wide scope of initiation of maize based rural entrepreneurship.

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