RESEARCH PAPER

Evaluation of Hybrid Maize (QPM) for Preparation of Nutritious Recipes of Various Foods Products Nutritional Security

Subbulakshmi, B*. and Amutha, S.

Tamil Nadu Agricultural University, Coimbatore-03, India
*Corresponding author: malayasubbu@gmail.com

Paper No.: 222 Received: 15-06-2018 Revised: 19-09-2018 Accepted: 23-11-2018

ABSTRACT

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. However, in spite of several important uses, maize has an inbuilt drawback of being deficient in two essential amino acids, viz., lysine and tryptophan. To overcome this, the breeding scientist mutated the opaque-2 (o2) gene in normal maize and made grain proteins in the endosperm nearly twice as nutritious as those found in normal maize. These mutations, which derive their names from soft, floury/opaque endosperm, alter the amino acid profile and composition of maize endosperm protein and result in two-fold increase in the levels of lysine and tryptophan in comparison with the normal genotypes which is called as Quality Protein Maize (QPM). Effective utilization of QPM in diversified way, by conversion into a variety of products for use as infant foods, health foods/mixes, convenience foods specialty foods and emergency ration can achieve the food and nutritional security of our country. Hence, the present study was undertaken to develop nutritious recipes based on QPM maize as flour and suji (semolina) by supplementing with pulses. Quality protein maize (QPM) was substituted in 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) were organoleptically evaluated using 9 point hedonic scale and also estimated their nutrient composition. All the products scored maximum acceptability and their nutrients content were higher compared to the native maize based products. Thus, their introduction could contributes food and nutritional security by meeting energy and protein needs of consumer.

Keywords: Hybrid maize, QPM, product development, commercialization

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 nutrient cereal. Globally, maize is known as a queen of cereals because it has the highest genetic yield potential among the cereals. Maize ranks third after wheat and rice as one of the world’s three leading food grains, are grown on 140 million hectare in 100 countries and produced 700 million metric tons of grain in 2004. The top six producers of maize in the world are United States, China, Brazil, Mexico, France, and India and they share the 75 per cent of total world maize production 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. Thus, discovery of maize
mutants in the mid-1960s containing the opaque-2 gene
which enhances levels of lysine and tryptophan in the
endosperm protein, opened a new era in breeding
for improvement of quality in maize. International
Maize and Wheat Improvement Center (CIMMYT)
identified the most productive maize cultivars with
high lysine and tryptophan contents. Through back
crossing and several recurrent selections, maize
breeders of CIMMYT and the National Research
Institute for Forestry, Agriculture and Livestock
(INIFAP) have successfully developed 26 hybrids
and cultivars, similar in yield and other important
agronomic properties to normal maize. These new
high-quality protein genotypes are collectively called
quality protein maize (QPM) (Milan-Carrillo et al.
2004).

Quality Protein Maize hybrids incorporate an
“opaque-2” gene identified from mutants within
maize which reduces the concentration of prolamine,
the dominant protein fraction in the regular maize
kernels that are high in leucine and isoleucine.
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. 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
specialty 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.

MATERIALS AND METHODS

The present study was carried out in the Food
Science and Nutrition department laboratory, Home
Science College and Research Institute. Madurai. The
normal maize variety CO1 bought from Department
of millets, Tamil Nadu Agricultural University
Coimbatore, Quality protein maize (QPM) variety
HQPM 7 was bought from Zonal Agricultural
Research Station (ZARS), Mandyal, Karnataka, India
and other ingredients used for the study were bought
from the local market.

Processing of value added products from maize

The CO1 and HQPM 7 maize varieties were
pulverized into flour and grits form in a commercial
mill and the flour was sieved using BS 60 mesh sieve.
Flour and grits were used for processing into different
ready-to-use and ready-to-eat value added products
at different incorporation levels of substitution.

Maize flour and refined wheat flour blends were used
to develop noodles, cookies and bread. While maize
flour and rice flour blends were used to develop
pittu mix and vadagam. Papad was developed using
maize flour and black gram flour blends. Traditional
south Indian foods like dosa and idli were developed
from maize, rice and black gram and pakoda from
maize flour, Bengal gram flour and rice flour blends.
Standard procedures and recipes were employed for
the production of various products.

The sensory quality attributes of the products
were evaluated using a nine point hedonic scale as
given by Srilakshmi (2006) to determine the level
of acceptability of the maize flour incorporated
products.

RESULTS AND DISCUSSION

The sensory scores of maize flour incorporated
traditional and ready to use convenience foods are
presented in Table 1.

Traditional foods

Papad prepared from 30 per cent maize flour
substitution recorded the maximum acceptability
in CO1 and HQPM 7 maize varieties and had the overall acceptability scores of 8.8±0.84 and 8.5±0.57, respectively. Vadagam, dehydrated product was prepared from whole maize flour of both the varieties obtained the overall acceptability scores of 8.4±0.31 and 8.6±0.56, respectively. Traditional foods namely, kesari, upuma and puliyotharai were prepared from 100 per cent CO1 as well as HQPM 7 maize grits and had the overall acceptability scores of 8.0±0.25, 8.5±0.47, 8.4±0.2, 8.3±0.55, 8.6±0.56 and 8.2±0.46, respectively. The south Indian breakfast products of idli and vada prepared from 50 and 75 per cent of maize and had the overall acceptability of 8.5±0.50, 8.5±0.49 and 8.5±0.57, 8.6±0.56 respectively in CO1 and HQPM 7 maize varieties. Singh et al. (2006) prepared three traditional products viz., mathi, pakoda and sev out of yellow maize (HM4). Maize flour was incorporated with about 80 percent in mathi and 40 per cent each in pakoda and sev preparation obtained the mean scores was above 7 for overall acceptability.

Siddaraju et al. (2008) reported that 30 per cent of winged yam flour incorporated two dehydrated food products viz, papad and sandige (dehydrated extruded product) was on par with control with respect to all sensory attributes and had overall acceptability scores of 7.5±0.66 and 6.4±0.67, respectively.

### Ready-to-use convenience foods

Ready to use dosa mix, pakoda mix, adai mix, pittu mix, kheer mix and nutriball mix prepared using both CO1 and HQPM 7 maize flour. Dosa mix and adai mix prepared with 50 and 40 per cent of maize flour, respectively. Kheer mix prepared from whole maize grits, pakoda mix and pittu mix made out of 75 per cent of maize flour. For nutri ball 60 per cent of maize flour added with 40 per cent of roasted Bengal gram flour. The overall acceptability of CO1 maize incorporated dosa mix, pakoda mix, adai mix, pittu mix, kheer mix and nutriball were 8.6±0.49, 8.5±0.50, 8.6±0.49, 8.3±0.49, 8.7±0.11 and 8.6±0.16 respectively.

---

### Table 1: Organoleptic scores of CO1 and HQPM 7 maize incorporated traditional and ready to use convenience food

| Sl. No. | Products | Level of incorporation | CO1 Colour | Appearance | Flavour | Texture | Taste | Overall acceptability | HQPM 7 Colour | Appearance | Flavour | Texture | Taste | Overall acceptability |
|---------|----------|------------------------|-----------|------------|---------|---------|-------|-----------------------|-------------|------------|---------|---------|-------|-------|----------------------|
| Traditional Foods |
| 1 | Papad | 30 | 8.5±0.62 | 8.7±0.58 | 8.7±0.47 | 8.4±0.58 | 8.8±0.68 | 8.8±0.84 | 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 | Vadagam | 100 | 8.6±0.67 | 8.1±0.37 | 8.2±0.44 | 8.7±0.50 | 8.4±0.32 | 8.4±0.31 | 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 | Kesari | 100 | 8.8±0.40 | 8.6±0.49 | 8.6±0.49 | 8.1±0.37 | 8.1±0.34 | 8.0±0.25 | 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 | Upma | 100 | 8.7±0.43 | 8.6±0.49 | 8.6±0.49 | 8.3±0.50 | 8.5±0.50 | 8.5±0.47 | 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 | Puliyotharai | 100 | 8.5±0.32 | 8.2±0.13 | 8.3±0.16 | 8.2±0.42 | 8.7±0.53 | 8.4±0.21 | 8.2±0.44 | 8.4±0.50 | 8.0±0.37 | 8.3±0.67 | 8.3±0.69 | 8.2±0.46 |
| 6 | Vada | 75 | 8.2±0.40 | 8.5±0.50 | 8.4±0.41 | 8.5±0.58 | 8.6±0.57 | 8.5±0.49 | 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 | Idli | 50 | 8.2±0.40 | 8.5±0.50 | 8.4±0.49 | 8.5±0.57 | 8.6±0.49 | 8.5±0.50 | 8.2±0.42 | 8.3±0.57 | 8.4±0.48 | 8.4±0.52 | 8.5±0.51 | 8.5±0.57 |
| Ready to use convenience foods |
| 8 | Dosa | 50 | 8.1±0.37 | 8.6±0.50 | 8.5±0.56 | 8.5±0.56 | 8.6±0.62 | 8.6±0.49 | 8.7±0.46 | 8.5±0.50 | 8.4±0.49 | 8.3±0.49 | 8.2±0.44 | 8.5±0.50 |
| 9 | Pakoda | 50 | 8.2±0.40 | 8.5±0.50 | 8.4±0.49 | 8.5±0.50 | 8.6±0.49 | 8.5±0.50 | 8.6±0.47 | 8.6±0.49 | 8.2±0.52 | 8.3±0.49 | 8.6±0.50 |
| 10 | Adai | 50 | 8.8±0.40 | 8.3±0.79 | 8.6±0.49 | 7.9±0.54 | 8.2±0.61 | 8.6±0.49 | 8.6±0.40 | 8.4±0.79 | 8.1±0.49 | 8.9±0.34 | 8.3±0.65 | 8.6±0.69 |
| 11 | Kheer | 100 | 8.1±0.31 | 8.4±0.82 | 8.5±0.21 | 8.7±0.23 | 8.8±0.54 | 8.7±0.11 | 8.1±0.31 | 8.6±0.82 | 8.5±0.21 | 8.5±0.13 | 8.8±0.54 | 8.7±0.18 |
| 12 | Pittu | 75 | 8.2±0.40 | 8.5±0.50 | 8.4±0.49 | 8.5±0.50 | 8.6±0.49 | 8.3±0.49 | 8.2±0.40 | 8.7±0.50 | 8.3±0.49 | 8.4±0.20 | 8.6±0.43 | 8.3±0.43 |
| 13 | Nutriball | 60 | 8.3±0.19 | 8.4±0.18 | 8.2±0.11 | 8.8±0.14 | 8.7±0.14 | 8.6±0.16 | 8.6±0.49 | 7.6±0.68 | 8.2±0.40 | 7.1±0.64 | 8.3±0.43 | 8.1±0.57 |

Values are mean ±SD.
However, the corresponding figures for HQPM 7 maize incorporated dosa mix, pakoda mix, adai mix, pittu mix, kheer mix and nutriball were 8.5±0.50, 8.6±0.50, 8.6±0.69, 8.3±0.43, 8.7±0.18 and 8.1±0.57 respectively. Premakumari et al. (2012) reported that 25 per cent incorporation of rice bran in ready to eat mixes viz., chapati, mixed vegetable chapati, wheat dosa, wheat rava idly, adai, rava adai, ragi adai, rice vermicelli, ragi vermicelli and kozhakattai had good acceptability. Yadav et al. (2011) formulated the instant mixes using ragi with different italics except and proportions. About 60 per cent ragi in dosa mix, 80 per cent in sankati mix (ragi rice balls) and 45 per cent in idli mix were found to be acceptable. Danak and Patel (2011) developed the instant idli mix using parboiled rice (25 per cent), ragi (25 per cent), kodri (20 per cent) and whole udad (20 per cent) which exhibited good scores in all sensory attributes.

The organoleptic scores of maize flour incorporated extruded foods and bakery foods are presented in Table 2.

### EXTRUDED FOODS

Extruded foods like noodles prepared using 50 per cent of refined wheat flour and 50 per cent of HQPM7 maize flour had higher overall acceptability (8.6±0.15) compared to the noodles from 50 per cent of refined wheat flour and 50 per cent CO1 maize flour (8.4±0.50). Balasubramanian et al. (2012) suggested that 85 per cent of maize flour and 15 per cent of legume flour namely, black gram, green gram, lentil and peas incorporated extrudates show the better quality of protein and recommended for the production of low cost instant flour and infant foods. Devi et al. (2013) developed ready to eat acceptable extruded products using foxtail millet and maize in the ratio of 60:40.

### BAKERY FOODS

Cookies and bread was prepared with acceptability up to the 75 per cent and 20 per cent of maize flour in both the varieties respectively. CO1 and HQPM7 based cookies had overall acceptability scores of 8.1±0.17 and 8.1±0.34 respectively and also CO1 and HQPM7 maize substituted bread had scores of 8.5±0.42 and 8.6±0.13 respectively. Rai et al. (2012) reported that 25 per cent of maize flour incorporated with wheat flour in bread preparation found to be acceptable. Nazni and Pradeepa (2010b) reported that 70 per cent of wheat flour and 30 per cent maize flour incorporated biscuits had an overall acceptability score of 8.60±0.73.

### CONCLUSION

The present study concluded that the HQPM 7 variety maize flour is expected to be better in terms of protein quality since the maize has adequate quantity of the amino acids compared to CO1 maize flour. 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.

REFERENCES


