

A Review on Quality Protein Maize (QPM) an Important Agroproduct for Food and Nutrition

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Abstract: *Maize is the third most important cereal in India after wheat and rice. Maize is a good source of carbohydrate, fats, proteins and some of the important vitamins and minerals. Several million people derive their protein and calorie requirements from Maize. Traditional maize has a drawback of being deficient in two essential amino acids viz. lysine and tryptophan. this leads to poor net protein utilization and low biological value of traditional maize genotypes. This problem has solved the maize breeders by developing the quality protein maize (QPM) by incorporating opaque-2 mutant gene, which is particularly responsible for enhancing lysine and tryptophan content of maize protein. Quality protein maize looks and taste like normal maize with same higher yield potential, but it contains nearly twice the quality of essential amino acids lysine and tryptophan, which makes it rich in quality proteins. The majority of the population depends on cereals for their livelihood in most of the countries and maize is the staple cereal food throughout the world. Therefore it was realized to improve the biological value of protein in maize genotypes. For this purpose a new corn type known as Quality Protein Maize (QPM) was developed by lowering the concentration of zein by 30%. As a result, the concentration of two essential amino acids viz lysine and tryptophan in grain was increased in QPM genotypes as compared to normal grain maize genotypes. This study aims to focus the cultivation of QPM rather than normal Maize*

Keywords: QPM, zein, lysine, tryptophan, proteins, amino acids

1. Introduction

Maize is a good source of carbohydrates, fats, proteins and some of the important vitamins and minerals. Several millions people, especially in the developing countries, derive their protein and calorie requirements from maize. Maize is the third most important cereal in India after wheat and rice. It is a staple food for human beings and quality feed for animals, maize serves as a basic raw material to the industry for production of starch, oil, protein, alcoholic beverages, food sweeteners and, more recently, bio-fuel. Being a potential crop in India, maize occupies an important place as a source of human food, animal feed, poultry feed, industrial products mainly as starch and in brewery and seed. Normal maize is being deficient in two essential amino acids, viz, lysine and tryptophan. this leads to poor net protein utilization and low biological value of traditional maize genotypes. To solve this problem, the maize breeders have developed quality protein maize (QPM) by incorporating opaque-2 mutant gene.

Cultivation of Quality Protein Maize in India – The QPM research was initiated during 1970's, but it gained momentum during 1990's with continuous breeding efforts on development of high yielding hard endosperm modified opaque-2 maize germplasm by International Centre for Maize and wheat Improvement (CIMMYT) and made it available for use in the breeding program all over the world. Normal maize is being deficient in two essential amino acids viz lysine and tryptophan. To overcome this problem the maize breeders have developed quality protein maize (QPM) by incorporating opaque-2 mutant gene which particularly responsible for enhancing lysine and tryptophan content of maize endosperm protein.

The QPM research gained further momentum by launch of National Agricultural Technology Project (NATP) on QPM in 1998 by the Indian Council of Agricultural Research

(ICAR). In this project, a multi-disciplinary team of multi institutes involved.

Nutritive Value of Quality Protein Maize (QPM):-Maize consists of three main parts-the hull or bran coat with high fibre content, germ rich in oil and starchy endosperm. The normal maize grain under Indian conditions on an average, contains 14.9% moisture, 11.1% protein, 3.6% fat, 2.7% fibre, 66.2% other carbohydrates and 1.5% minerals (National Institute of Nutrition, 2002). Maize kernel protein is made up of five different fractions. The percentage of different fractions to total nitrogen in maize kernel is albumin 7%, globulin 5%, non protein nitrogen 6%, prolamine 52% and glutelin 25% and the left over 5% is residual nitrogen. Protein being the primary structural and functional component of every living cell is one of the most important ingredients that determine the quality of food and feed.

In normal maize grain the quality of protein is poor due to the presence of largest concentration of an alcohol soluble protein fraction 'prolamine' also known as 'Zein' in the endosperm. The amount of this alcohol soluble protein fraction zein is low in immature maize. They increase as the grain matures. Zein is very low in lysine and tryptophan content. Since this fraction contributes more than 50% of the total protein, due to this obvious reason the protein of normal maize grain is low in lysine and tryptophan content. Zein fractions contain very high amount of leucine and imbalanced proportion of isoleucine. On the whole, the ill proportion of all these four essential amino acids in maize due the high content of zein results into the poor quality of protein in normal maize. The high quality of protein in other fractions in the other parts of maize kernel become recessive due to the dominance of zein in normal maize. The poor quality of protein in normal maize affects its 'Biological value' i. e. the availability of protein in the body.

For this purpose, a new corn type known as 'Quality Protein Maize (QPM)' was developed by lowering the concentration of zein by 30%. As a result, the concentration of two essential amino acids viz., lysine and tryptophan in grain was increased in QPM genotypes as compared to normal grain maize genotypes. The lower content of leucine in QPM further balances the ratio of leucine to isoleucine content (Table). The balances proportion of all these essential amino acid in Quality Protein Maize (QPM) enhanced the biological value of protein. The True Protein Digestibility of normal maize and Quality Protein Maize is almost same, but the biological value of the normal maize (40-47) is just half as compared to that of QPM (80) varieties. Rather, the biological value of QPM is highest among all the food grains.

Table: Comparison on Essential Amino Acid Content in Normal Maize and QPM Grain

| Amino acid | Amino acid content (mg per g N) | |
|----------------------|---------------------------------|-----------|
| | Normal grain | QPM grain |
| Lysine | 177 | 256 |
| Isoleucine | 206 | 193 |
| Leucine | 827 | 507 |
| Sulfur amino acids | 188 | 188 |
| Aromatic amino acids | 505 | 502 |
| Threonine | 213 | 199 |
| Tryptophan | 35 | 78 |
| Valine | 292 | 298 |

Uses of Quality Protein Maize

In India, the maize is mainly consumed as feed and food and hence, QPM being superior in quality has better option in these sectors. The main uses of QPM are as follows:-

- **For food and nutritional security:-**The Quality Protein Maize (QPM) has got special distinction among the cereals due to presence of high amount of two essential amino acids viz., lysine and tryptophan and low content of non desirable amino acid (leucine). Therefore, the QPM can be utilized for diversified purposes in food and nutritional security as infant food, health food/mixes, convenience foods, speciality foods and emergency ration. It is also useful in fulfilling the protein requirements of different sections of society (infants, lactating mother's convalescing patients, Kwashiorkor diseased and old persons) to prevent malnutrition. The Quality Protein Maize (QPM) has been found superior food for human being.
- **Providing nutritious feed:** The recent projections of International Food Policy Research Institute (IFPRI) has indicated that there will be 85 and 45% increase in global demand for poultry and pork for which maize is the major source of feed that indicates growing demand for maize globally. Quality Protein Maize (QPM) with its high carbohydrates, fats, better quality proteins, some of vitamins and minerals, it is nutritious feed for poultry, livestock, swine, fish, etc. Use of QPM as poultry feed leads to early development of broilers, save energy and feed, and also the extra cost incurred on lysine and tryptophan fortification.
- **Promoting maize based entrepreneurship:** The nutritious products developed from QPM can replace fancied and highly priced industrial foods. These products can also be prepared in villages and thus could

be a great source of rural entrepreneurship. Therefore, QPM based rural industries has a wider scope for employment generation and rural prosperity

2. Conclusion

The majority of the population depends on cereals for their livelihood in most of the countries and maize is the staple cereal food throughout the world. Therefore it was realised to improve the biological value of protein in maize genotypes. To overcome this problem the maize breeders have developed quality protein maize (QPM) by incorporating opaque-2 mutant gene, which is particularly responsible for enhancing lysine and tryptophan content of maize endosperm protein. Being a potential crop in India maize occupies an important place as a source of human food, animal feed, poultry feed, industrial products mainly as starch and brewery and seed. The QPM could be a cheaper source of protein for children and can be used effectively as mid day meal. QPM can also be used for treatment of so many diseases which required maximum quality protein in diet.

Thus quality protein maize can be a strong support to the mission of food and nutritional security of the country particularly in under privileged and tribal regions of India where maize is consumed as a staple food. QPM will also ensure quality feed for poultry and animal sector which are the largest consumers of maize in India. The cultivation of QPM will ensure higher income to farmers as well as nutritionally superior food to the consumers. Government should be encouraged the farmers for cultivation of QPM and should provide high quality seeds and other facilities in low cost. Thus Quality protein Maize is an important source of food and nutrition and it could be a great source of rural entrepreneurship. Therefore QPM based rural industries has a wider scope for employment generation and rural prosperity in India. This review paper would be useful in the field of science and agriculture and can play an important role in economical development of the country.

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