

Review Article

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## Sweet Corn – A Future Healthy Human Nutrition Food

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### ABSTRACT

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Sweet corn (*Zea mays* L.) being staple food crop is used as a nutritional source for humans. Sweet corn, a member of the *Gramineae* family is available in wide varieties globally but variety preference is different for each region. Unlike field corn varieties, standard yellow sweet corn is the most commonly known Sweet corn variety, which are harvested at full maturity, sweet corn is picked when immature, it is a costly and perishable vegetable with short shelf life due to higher respiration rate efforts are needed to promote processing of sweet corn so as to enhance its shelf life and prevent post-harvest losses. In the present article, nutritional composition and their benefits on human health have been discussed.

### Introduction

Maize (*Zea mays* L.) is one of the most important cereal grains grown worldwide in a wider range of environments because of its greater adaptability. As the leading cereal crop in the world, corn (*Zea mays* L.) plays a significant role in human foods. Corn known as maize to many people, is the leading cereal crop in the world followed by rice and wheat. Maize growers are shifting to specialty corn production due to higher returns and also opening opportunities for employment generation especially in urban areas. Among specialty corns, sweet corn has a very big

market potential and has great genetic variability and scope to improve its nutritive value. It is grown extensively in temperate, tropical and sub-tropical regions of the world.

Sweet corn [*Zea mays* (L.) var. *saccharata*] is a cultivated plant grown for human consumption and is a raw or processed material of the food industry throughout the world. It is popular with the consumer for its unique taste, pleasant flavor and sweetness. Sweet corn also known as sugar corn, is a hybridized variety of maize (*Zea mays* L.) specifically bred to increase the sugar content and provides green ears in 75 to 90 days after

sowing. Sweet corn contains 5-6% sugar, 10-11% starch, 3% water soluble polysaccharides and 70% water, besides moderate levels of protein and vitamin (yellow varieties) and potassium (Oktem and Oktem, 2005). Sweet corn plays an important role in the human diet because of its health- promoting nutritional characteristics.

Sweet corn is the new age super diet for health conscious people. The nutritive value of sweet corn is comparable to several high priced vegetable like cauliflower, cabbage, french beans, fibre content and low in cholesterol. The nutritional value of sweet corn kernels is related to the content of water (72.7%) and to the total content of solid parts (27.3%). Solid parts include hydrocarbons (81%), proteins (13%), lipids (3.5%) and others (2.5%). Starch is the dominant hydrocarbon component (Szymanek, 2012). Sugar corn kernels are moderately high in calories in comparison to other vegetables. Corn features high quality phyto-nutrition profile comprising of dietary fibre, vitamins and antioxidants in addition to moderate proportion of minerals. Sweet corn contains significant amount of lutein, zeaxanthin and other carotenoids (Junpatiw *et al.*, 2013). Sweet corn has been widely consumed as a healthy food since it is rich in carotenoids. Carotenoids, such as the xanthophyllus, lutein and zeaxanthin, have garnered interest due to their association with eye health (More *et al.*, 2018 and Ozata, 2019). It is one of the most popular vegetable in the western and advanced countries of the world.

Sweet corn is rich in carbohydrates and sugars and contains useful amounts of vitamins A, B3 (which supports metabolism, the nervous and digestive systems) and C. It also contains folic acid, fibre, minerals and protein (Gebhardt and Matthews, 1981). The total sugars in sweet corn ranges from 25-30 percent (Ramachandrapa and Nanjappa,

2006). Perhaps the most surprising is that it offers even greater health benefits when cooked. The Sweet corn's antioxidant activity is significantly increased when cooked, helping to battle cancer, heart disease and protect against cataracts. There is notion that processed fruits and vegetables have a lower nutritional value than fresh produce. Those original notions seem to be false, as cooked sweet corn retains its antioxidant activity, despite the loss of vitamin C. It has been reported that thermal processing at 115<sup>0</sup>C for 25 minutes significantly elevated the total antioxidant activity of sweet corn by 44 per cent and 54 per cent, although 25 per cent vitamin C loss was observed (Dewanto *et al.*, 2002).

Sweet corn is a member of the *Gramineae* (grass family) along with barley, wheat, and rice. This mutated grass is native to the tropical environments of the America. Sweet corn is used as human food at the milk stage of the endosperm development when the kernel is soft, succulent and sweet (Pajic *et al.*, 2004). Unlike field corn varieties, which are harvested when the kernels are dry and fully mature (dent stage), sweet corn is picked when immature (milk stage) and can be harvested in 75-80 days after planting and eaten as a vegetable, rather than grain (Schultheis, 1994). There are many varieties of sweet corn available, but variety preference is different for each region. Standard yellow sweet corn is the most commonly known variety.

Sweet corn varies from normal corn essentially for gene(s) that affect starch synthesis in the seed endosperm where in the recessive sugary (su) allele elevates the level of water soluble polysaccharides (sugars) and decreases starch. Thus the kernels of sweet corn taste sweet especially at 18 to 21 days after pollination. Super sweet or extra sweets have a shrunken (sh) gene, a name that

describes the light-weight, wrinkled seed of this group. This gene raises original levels of complex sugars even further, again extending their flavour by slowing conversion to simple sugars and finely to starch. Moisture also is retained in this type, and shelf life is remarkably long. There usually will be more seed per lb. in the super sweet (sh) types due to low seed density (Duffy and Calvert, 2010). New “high sugar or sweeter” varieties with longer shelf life are being adopted for consumption (Lertat and Pulam, 2007). The kernels are boiled or steamed, and usually served with butter and salt. In Europe, China, Korea and Japan, they are often used in pizza, or in salads. Sweet corn is gaining importance in the star hotels and urban areas for the preparation of vegetables, special soups, syrup, sweets, jams, cream, pastes and other delicious eatables.

### **Nutritional value and health benefits**

#### **Nutritional composition**

Sweet corn is a particular maize species which differ genetically from the field maize. Its kernels are tender, delicious and eaten as a vegetable in many cuisines worldwide. In contrast to the traditional field corn, sweet corn crops are harvested while their corn-ears have just attained the milky stage. The cob either used immediately or frozen for later use since its sugar content turns quickly into starch. At 86 calories per 100 g, sugar corn kernels are moderately high in calories in comparison to other vegetables. However, fresh sweet corn has much fewer calories than that of in the field corn and other cereal grains like wheat, rice, etc. Their calorie chiefly comes from simpler carbohydrates like glucose, sucrose than complex sugars like amylose and amylopectin, which is a case in the cereals. Sweet corn is a gluten-free cereal and may be used safely in celiac disease individuals much like rice, quinoa, etc. Sugar

corn features high-quality phytonutrition profile comprising of dietary fiber, vitamins, and antioxidants in addition to minerals in modest proportions. It is one of the finest sources of dietary fibers, 100 g kernels carry 2 g or 5% of daily requirement of dietary fiber. Together with slow digesting complex carbohydrates, dietary fiber in the food helps to regulate in a gradual increase in blood sugar levels.

However, corn, in line with rice, potato, etc., is one of high glycemic index food items, limiting its authority as the chief food ingredient in diabetes patients. Yellow variety corn has significantly higher levels of phenolic flavonoid pigment antioxidants such as  $\beta$ -carotenes, and lutein, xanthins and cryptoxanthin pigments along with vitamin-A. 100 g fresh kernels provide 187 IU or 6% of daily requirement of vitamin-A. Altogether; these compounds are required for maintaining healthy mucosa, skin, and vision. Consumption of natural foods rich in flavonoids helps protect from lung and oral cavity cancers. Corn is a good source of the phenolic, flavonoid, antioxidant and ferulic acid. Several research studies suggest that ferulic acid plays a vital role in preventing cancers, aging, and inflammation in humans.

It also contains good levels of some of the valuable B-complex group of vitamins such as thiamin, niacin, pantothenic acid, folates, riboflavin, and pyridoxine (Dilip Kumar and Aditya Narayan Jhariya, 2013). Many of these vitamins function as co-factors to enzymes during substrate metabolism. Further, it contains healthy amounts of some essential minerals like zinc, magnesium, copper, iron, and manganese (Source; USDA National nutrient data base).

Sweet corn is rich in carbohydrates and sugars and contains useful amounts of vitamins A, B3 (which supports metabolism, the nervous

and digestive systems) and C. It also contains folic acid, fibre, minerals and protein (Gebhardt and Matthews, 1981). Brewbaker *et al.*, (1975) reported a range of 46% total sugars, 18% starch, 14.5% protein and 17% oil in sweet corn. Biochemical characteristics of super-sugar corn and the possibility of its utilization studied by Shmaraev *et al.*, (1976) revealed that grain of super-sugar corn harvested at technical maturity contained 24-30% dry matter 36.8% total sugar, no or very little dextrin and 21.9% starch compared with 16.7% sugar, 24.2% dextrin and 30.1% starch.

The high sugar content made it possible to harvest the ears during a longer period than that acceptable for sweet corn and to store the harvested ears for a few days without losses of sugar. Grain of super-sugar corn contained more lysine than that of sweet corn. The absence of dextrin was, however, regarded as a negative feature. Oliveira *et al.*, (1991) studied nutritional attributes of a sweet corn fibrous residue. A sweet corn fibrous byproduct with 72.7% Neutral Detergent Fiber (NDF) was chemically and nutritionally characterized. The fiber components were hemicellulose, 67.9%; cellulose 31.4%; and lignin, 0.7%. Makhlof *et al.*, (1995) studied some nutritional characteristics of sweet corn; sweet corn was reported to contain 75.7 per cent moisture, 6.8mg/100g vitamin C, 2.0mg/100g calcium, 37mg/100g magnesium, 15.2mg/100g sodium on fresh matter basis. Dewanto *et al.*, (2002) reported that processed sweet corn has higher antioxidant activity despite the loss of vitamin C. Processed sweet corn has increased antioxidant activity equivalent to 210 mg of vitamin C/100g of corn compared to the remaining 3.2 mg of vitamin C in the sample that contributed only 1.5 per cent of its total antioxidant activity. Yue *et al.*, (2003) studied the change of carbohydrate and taste quality in the kernels of super sweet corn in the milky maturity stage. Results showed that the soluble sugar

and sucrose contents peaked at 16-18 days after pollination, while moisture and reducing sugar decreased. Kernel taste was significantly correlated with sweetness sucrose and moisture. The correlation coefficient between sucrose and taste or between crude fibre and taste were also significant. Coskun *et al.*, (2006) reported the physical properties of sweet corn. The average length, width and thickness were 10.56 mm, 7.91 mm and 3.45 mm, at a moisture content of 11.54 per cent dry basis, respectively. The bulk density decreased from 482.1 to 474.3 kg m<sup>-3</sup> with an increase in the moisture content range of 11.54–19.74 per cent dry basis. Fikret and Aydemir (2018) reported that sweet corn contains 13% water, fat 4.6%, proteins 11.2% and 72.3% starch higher than any corns. It also contains vitamin A, B and C vitamins plus zinc, iron and magnesium minerals etc. Siyuan *et al.*, (2018) reported sweet corn has unique profiles of nutrients and phytochemicals when compared with other whole grains. Corn contains nutrients and phytochemicals include vitamins (A, B, E, and K), minerals (Mg, P, and K), phenolic acids (ferulic acid, coumaric acid, and syringic acid), carotenoids and flavonoids (anthocyanins), and dietary fiber. Yingni Xiao *et al.*, (2020) studied Vitamin E, consisting of tocopherols and tocotrienols, serves as a lipid-soluble antioxidant in sweet corn kernels, providing nutrients to both plants and humans. These results shed light on the genetic architecture of vitamin E and may accelerate the nutritional improvement of sweet corn.

### **Health benefits of sweet corn**

Aslam, 2018, reported that Sweet corn contains ferulic acid, which is an antioxidant found in the cell walls and insoluble parts of sweet corn, Sweet corn contains more ferulic acid than any other fruit or vegetable, and with recent research showing that ferulic acid

can ward off disease, cancer, diabetes, heart disease and neurodegenerative diseases such as Alzheimer's disease, sweetcorn is fast becoming a bit of a wonder food. Corn offers 342 calories in a serving size of 100 grams. It also has low content of glycemic index. Foods with high content of glycemic index such as white bread and white rice breaks down rapidly and causes blood sugar and jump of insulin level followed by active crashing of blood sugar levels. Sweet corn is absorbed slowly into bloodstream result in stabilizing blood sugar level.

Arakelyan (2019) reported that sweet corn has high content of B vitamin constituents such as niacin and thiamin. Thiamin is required to maintain proper nerve health as well as cognitive function. Niacin helps to promote good cholesterol and lowers the chances of cardiovascular problems. Insufficient niacin causes Pellagra which is a disease indicated by dementia, diarrhea, insomnia, dermatitis and inability to sleep. Sweet corn contains pantothenic acid which is considered to be an essential vitamin for protein, carbohydrate and lipid metabolism in the body.

Folic acid assists in production of healthy red blood cells and prevent anemia. Additionally, it is required to aid rapid cell growth and division such as during pregnancy and infancy. In pregnant women, the deficiency of folic acid results birth of underweight infants and results neural tube defects in newborns. Anemia is an insufficient amount of red blood cells or amount of hemoglobin in blood. Folic acid and Vitamin B12 helps to prevent the chances of anemia caused by deficiency of vitamin (Dilip and Aditya, 2013).

Sweet corn is a great source of iron which is required for the formation of new red blood cells. Niacin is essential for good cholesterol and lowers the chances of cardiovascular ailments. Corn husk oil helps to lower bad

cholesterol. It helps to lower the risk of heart problems and atherosclerosis. Sweet corn has high content of beta carotene; forerunner to Vitamin A. Beta carotene is turned into Vitamin A and provides maintenance of skin and vision. Vitamin A also assists mucus membranes and promotes immune system. Beta carotene is not transformed into Vitamin A which acts as an antioxidant and counteracts heart disease and cancer. Corn starch is used in various cosmetic products and also applied to skin for soothing irritation and rashes. Corn products are used to restore carcinogenic petroleum products that are major constituents of cosmetic preparations.

Sweet corn has vitamin B which regulates lipid, protein and carbohydrate metabolism and phytochemicals regulate release of insulin. Sweet corn possess glycemic index of 58 which is a smart choice for diabetic people. Phenolic phytochemicals found in it also control hypertension.

Sweet corn is a perfect for those who want to maintain their youthful looks and remain young. It has high content of antioxidants which prevent and also slows down aging process. The kernels of Sweet corn have beta carotene which forms vitamin A promoting better vision. Carotenoids also help to lower macular degeneration that impairs vision at center of line of sight.

From the literature study it was eventualized that sweet corn has worldwide importance due to its nutritional value and health benefits, it is not only used for food but its waste also has unique importance in industries and for animals, so based on such benefits, it is suggested to make it part of daily diet and it has also been concluded that sweet corn is not yet scientifically fully explored for its composition and values, and still requires researcher's attention so as to explore this plant for the new era of science.

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