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A review on the study of nutritional composition and health benefits of sweet corn (*Zea mays* L.) and coconut (*Cocos nucifera* L.) oil

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Abstract

A significant cereal crop worldwide is maize, sometimes known as corn (*Zea mays* L.). First grown in the USA, fresh sweet corn has since been exported to a number of other countries, where it has become popular as a favourite vegetable. By having one or more recessive alleles in the pathway that produces starch in the maize endosperm, modern sweet corn can be separated from other vegetable corns. When consumed fresh, this has the effect of lowering the starch level and raising the sugar concentration. Both phytochemical substances and nutrients can be found in it. In order to avoid chronic illnesses, phytochemicals are crucial. Most individuals eat fats and spreads on a regular basis, giving an ideal platform for beneficial additives. Lauric acid, which is a significant component in coconut oil's medium-chain fatty acid composition. Coconut oil is different from long-chain triglyceride saturated oil in the way it is digested, and as a result, it offers several nutritional benefits and health-promoting properties. Being an essential food with important physiological functions, coconut oil plays a special role in the diet.

1. Introduction

Corn is a cereal crop belonging to the Poaceae grass family, sometimes known as Indian corn or maize. A grain that can be eaten. The most extensively planted food crop in the world is maize, a domesticated plant that was first grown in the Americas. A food for humans, corn is also employed in industry as a raw material and as a biofuel. Corn is the primary cereal crop, followed by wheat and rice. There is a lot of room to improve corn's nutritional value because it has a huge genetic variety and a huge commercial potential. The world's tropical, subtropical, and temperate regions all support significant cultivation of it. Consequently, prospects for job creation, particularly in metropolitan areas, arise as a result of improved production output. Sweet corn, one of the specialty corns, has one of the largest market potentials and the most genetic diversity, giving it the potential to have its nutritional value increased. Food processing is one of the most industries in the global economy and is expanding rapidly (Haque *et al.*, 2022).

The food industry uses *Zea mays* (L.) var. *saccharata*, a cultivar produced for human consumption, as a raw or processed food source all over the world. Its distinct flavor, agreeable flavor, and sweetness have made it popular with consumers. Green ears of sweet corn, sometimes referred to as sugar corn, are produced 75 to 90 days after planting. Sweet corn is a hybridized cultivar of maize developed specifically to boost the sugar content (*Zea mays* L.). Sweet corn also contains a modest amount of protein, vitamin (yellow kinds), potassium, carbohydrate, sugar, and water-soluble

polysaccharides, along with a majority of water (70%) and starch (10-11%) (Oktem and Oktem, 2005). Because of the nutritional benefits that sweet corn provides to human health, it is a significant part of the human diet. For those who are health conscious, sweet corn is the newest super food. Several expensive vegetables, such as cauliflower, cabbage, and French beans, have equivalent nutritional value to sweet corn, which is also low in cholesterol and has a high fiber content. The nutritional value of sweet corn kernels is correlated with their percentages of water (72.7%) and total solids (27.3%). Solid components are primarily composed of hydrocarbons (81%), followed by proteins (13%), lipids (3.5%), and other substances (2.5%). The main hydrocarbon component is starch (Szymanek, 2012).

Compared to other vegetables, sweet corn kernels have a mediocre amount of calories. In addition to dietary fiber, vitamins, and antioxidants, corn also has a moderate amount of minerals, making it a source of high-quality phytonutrients. Lutein, zeaxanthin, and other carotenoids are abundant in sweet corn (Junpatiw *et al.*, 2013). Since sweet corn is a food that is high in carotenoids, it has been widely used as a healthy food (Swapna *et al.*, 2020). Because of its connection to eye health, carotenoids including lutein, zeaxanthin, and xanthophyllous have attracted attention (More *et al.*, 2018; Ozata, 2019). In the western and developed nations of the world, it is one of the most consumed vegetables. Unexpectedly, when cooked, it has even greater health benefits. The antioxidant activity of sweet corn is significantly increased while cooking, helping in the treatment of cancer, cardiovascular disease, and cataracts (Dewanto *et al.*, 2002). Those initial assumptions appear to be incorrect because cooked sweet corn still has antioxidant action even when vitamin C is lost (Dewanto *et al.*, 2002). According to reports, thermal processing sweet corn at 1150°C for 25 min dramatically increased its overall antioxidant activity by (44%) and (54%), despite a (25%) loss in vitamin C (Dewanto *et al.*, 2002). At

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the milk stage of endosperm growth, when the kernel is tender, succulent, and sweet, sweet corn is utilized as nourishment for humans (Pajic *et al.*, 2004). Although, there are numerous sweet corn kinds, each location has its own preferences. The most popular type of sweet corn is standard yellow. Consumers are embracing new “high sugar or sweeter” types with extended shelf lives (Lertat and Pulam, 2007). The kernels are typically served with salt and butter after being boiled or steamed. They are frequently used in pizza or salads in Europe, China, Korea, and Japan. Sweet corn is gaining popularity in upmarket hotels and urban regions for use in the production of vegetables, specialty soups, syrup, sweets, jams, cream, pastes, and other exquisite delicacies.

2. Nutritional composition and health benefits

2.1 Nutritional composition

Sweet maize is a particular kind of maize that differs genetically from field maize. Its soft, flavorful kernels are consumed as a vegetable in a number of international cuisines. Unlike regular field corn crops, sweet corn is picked when its corn ear remains in the milky stage. Since the corn’s sugar content quickly changes into starch, it should either be consumed right once or frozen for later use. Sugar corn kernels have a calorie content that is somewhat high compared to other vegetables, at 86 calories per 100 g. However, compared to other cereal grains like wheat, rice, and other in-field crops of corn, fresh sweet corn has far fewer calories. Similar to cereals, they include more calories from less complex carbohydrates like amylopectin and amylose and more from simpler carbohydrates like glucose and sucrose. Sweet corn is a gluten-free cereal that people with celiac disease can eat without any issues, just as rice, quinoa, *etc.* One of the greatest sources of dietary fiber, 100 g of kernels supply 2 g, or (5%) of the daily need.

Dietary fiber in meals helps to control a steady rise in blood sugar levels, working in conjunction with slowly digesting complex carbs. In addition to vitamin A, yellow-type maize includes substantially higher concentrations of the phenolic flavonoid pigment antioxidants b-carotenes, lutein, xanthine, and cryptoxanthin pigments. 100 g of fresh kernels give 187 IU, or (6%) of the recommended daily intake, of vitamin A. These substances taken together are necessary for sustaining healthy mucosa, skin, and eyesight. Flavonoids found in natural foods help prevent malignancies of the mouth and lungs. In terms of phenolic, flavonoid, antioxidant, and ferulic acid content, corn is an excellent supplier. Numerous studies indicate that ferulic acid is essential for protecting against human malignancies, ageing, and inflammation. As sweet corn has a high sugar content, it was possible to pick the ears for longer than usual and to store them for a few days without sugar degradation. The lysine content of super-sugar corn grains was higher than that of sweet corn grains. Chemical and dietary characteristics of a fibrous byproduct of sweet maize containing (72.7%) neutral detergent fiber (NDF) were determined. Hemicellulose made up (67.9%) of the fiber, followed by cellulose (31.4%) and lignin (0.7%). Sweet corn was found to have, on a fresh matter basis, (75.7%) moisture, 6.8 mg of vitamin C per 100 g of food, 2.0 mg of calcium, 37 mg of magnesium, and 15.2 mg of sodium (Makhlouf *et al.*, 1995). Despite losing its vitamin C content, sweet corn still has better antioxidant activity (Dewanto *et al.*, 2002). In comparison to the remaining 3.2 mg of vitamin C in the sample, which accounted for just (1.5%) of the sample’s entire antioxidant activity, 210 mg of vitamin C per 100 g of treated sweet

corn has greater antioxidant activity. The very sweet maize kernels vary in flavor and carbohydrate content at the milky maturity stage. The average length, breadth, and thickness were 10.56 mm, 7.91 mm, and 3.45 mm on a dry basis with a moisture level of (11.54%). The bulk density decreased from 482.1 to 474.3 kg m when moisture content increased in the (11.54%-19.74%) dry basis range (-3). According to other corns, sweet corn has the maximum levels of water (13%), fat (4.6%), proteins (11.2%), and starch (72.3%) (Budak and Aydemir, (2018). Additionally, it has minerals like zinc, iron, and magnesium as well as vitamins A, B, and C (Budak and Aydemir, (2018). Dietary fiber, phenolic acids (ferulic, coumaric, and syringic acid), vitamins A, B, E, and K, minerals Mg, P, and K, and carotenoids as well as flavonoids (anthocyanin) are among the phytochemicals and nutrients present in maize. In sweet corn kernels, vitamin E, which is composed of tocopherols and tocotrienols, functions as a lipid-soluble antioxidant and provides nutrients to both plants and people (Xiao *et al.*, 2020). These discoveries shed light on the genetics of vitamin E and could speed the improvement of sweet corn’s nutritional status.

Table 1: Nutritional value of raw sweet corn per 100 g

Principle	Nutrient value	Percent of RDA
Energy	86 Kcal	4%
Carbohydrates	18.70 g	14%
Protein	3.27 g	6%
Total fat	1.35 g	7%
Cholesterol	0 mg	0%
Dietary fiber	2.0 g	5%
Vitamins		
Folates	42 µg	10.5%
Niacin	1.770 mg	11%
Pantothenic acid	0.717 mg	14%
Pyridoxine	0.093 mg	7%
Riboflavin	0.055 mg	4%
Thiamin	0.155 mg	13%
Vitamin A	187 IU	6%
Vitamin C	6.8 mg	11%
Vitamin E	0.07 mg	<1%
Vitamin K	0.3 µg	2%
Electrolytes		
Sodium	15 mg	1%
Potassium	270 mg	6%

Minerals		
Calcium	2 mg	<1%
Copper	0.054 mg	6%
Iron	0.52 mg	6.5%
Magnesium	37 mg	9%
Manganese	0.163 mg	7%
Selenium	0.6 µg	1%
Zinc	0.46 mg	4%
Phytonutrients		
Carotene-b	47 µg	—
Carotene- α	16 µg	—
Cryptoxanthin-b	115 µg	—
Lutein-zeaxanthin	644 µg	—

Source: USDA national nutrient data base (2020)

2.2 Health benefits of sweet corn

Antioxidant ferulic acid is found in the insoluble parts and cell walls of sweet maize. The greatest amount of ferulic acid found in any fruit or vegetable is found in sweet corn, and new research has revealed that ferulic acid aids in the prevention of diseases such as cancer, diabetes, cardiovascular disease, including neurological conditions like Alzheimer's disease (Swapna *et al.*, 2020). A 100 g portion of corn contains 342 calories. Additionally, it contains low glycemic index. Slow blood sugar absorption from sweet corn stabilizes blood sugar levels. Niacin and thiamin, B vitamin components, are particularly abundant in sweet corn. Both healthy nerves and adequate cognitive function depend on thiamin. Niacin promotes healthy cholesterol and reduces the risk of cardiovascular issues. Pellagra, a disorder marked by dementia, diarrhea, insomnia, rashes, and trouble sleeping, is brought on by a niacin shortage. Pantothenic acid, a vitamin important for the body's metabolism of proteins, carbohydrates, and lipids, is found in sweet corn. In order to avoid anemia, folic acid aids in the creation of healthy red blood cells. It is also necessary to promote fast cell division and expansion, such as that seen in pregnancy and early childhood. Underweight babies are born as a result of folic acid shortage in pregnant mothers, and newborns have abnormal neural tubes. Anemia is characterized by a lack of hemoglobin or red blood cells in the blood. The combination of vitamin B12 deficiency and folic acid reduces the risk of anemia (Kumar and Jhariya, 2013).

Iron, which is rich in sweet corn, is necessary for the creation of new red blood cells. Niacin is crucial for maintaining healthy cholesterol levels and reduces the risk of cardiovascular diseases. Bad cholesterol is reduced with corn husk oil. Atherosclerosis and heart disease risk are both reduced by it. Vitamin B, found in sweet corn, controls the metabolism of lipids, proteins, and carbohydrates, and phytochemicals control insulin release. Phytochemicals are bioactive chemical substances that occur naturally in plants and are

beneficial to human health. They may also lower the chance of developing serious chronic illnesses (Liu, 2004). Carotenoids, phenolic compounds, and phytosterols, among other important phytochemicals, are all found in significant amounts in maize (Jiang and Wang, 2005)

Table 2: Composition of a 100 g serving of edible maize

Carbohydrates	71.88 g
Protein	8.84 g
Fat	4.57 g
Fiber	2.15 g
Moisture	10.23 g
Phosphorus	348 mg
Sodium	15.9 mg
Sulphur	114 mg
Riboflavin	0.10 mg
Amino acids	1.78 mg
Minerals	1.5 g
Calcium	10 mg
Iron	2.3 mg
Potassium	286 mg
Thiamine	0.42 mg
Vitamin C	0.12 mg
Magnesium	139 mg
Copper	0.14 mg

Source: Rouf *et al.* (2016).

3. Application of sweet corn in cream spread

The majority of people in Western nations get about one-third of their calories from fat. Fats and spreads include a number of substances with health benefits in addition to being a concentrated source of energy, such as certain fatty acids and vitamins. Most individuals use spreads on a regular basis, making them an ideal platform for beneficial additives. Functional components may now be included into a wide range of items, thanks to new technology. Reduced fat products have gained popularity as a result of the overall trend toward consuming less fat, and at the moment, spreads can range in fat content from almost no fat to (80%) fat. New fat-soluble and water-soluble functional compounds have been introduced to fats and spreads during the past 20 years. Numerous compounds that may be added to spreads and fats have been found to positively impact chronic disease risk factors (Turpeinen and Merimaa, 2011). In order to enhance their chemical, physical, and nutritional qualities and make them more suited for uses, fats and oils can be modified using a variety of technical and biological techniques.

4. Cream

According to its health-promoting qualities and a thriving industry, milk and its derivatives are currently in high demand (Singh *et al.*, 2022). Due to greater contributions from the watery phase of milk and the fat globule membrane, cream is expected to taste different from sweet cream butter (Badings and Neeter, 1980). Cream is a yellow component of milk that is removed. The less dense fat appears at the top in homogenized milk. The cream derived from goat milk is white in color. The golden tone of the cream is provided by animals that graze on natural pasture.

4.1 Effect of cream on human health

4.1.1 Heart diseases

Cream-based products have a key role in supplying the human diet with a variety of nutrients that boost the immune system. They aid in the prevention of human degenerative conditions as osteoporosis, cancer, atherosclerosis, and other diseases. Some ingredients, especially peptides, lipids, minerals, and vitamins, are nutrient-rich and have high medicinal value and lifespan (Hae Soo *et al.*, 2013). Cream's linoleic acid assists people by reducing their chance of developing heart disease (Nagpal *et al.*, 2012).

4.1.2 Anticancer effects

Several studies have found that MFGM proteins can help inhibit cancer cell development in people (Spitsberg, 2005). Fatty acid binding protein, one of the MFGM proteins, prevents the development of breast cancer cell lines at extremely low concentrations (Kromminga *et al.*, 1990).

4.1.3 Antibacterial and antiadhesive effects

Humans' gastrointestinal tracts benefit from the antibacterial and anti-adhesive properties of MFGM proteins.

4.1.4 Improves eye health

Cream is extremely rich in many antioxidants, including vitamin A, and it is particularly beneficial in preventing oxidative damage to our retina brought on by dangerous free radicals. Additionally, the cream's antioxidant capabilities assist in scavenging free radicals and preventing them from oxidative damaging our eye cells, which is the primary cause of macular degeneration and can result in blindness.

5. Coconut oil

One of the most significant rainforest plants is the coconut (*Cocos nucifera* L.), which is cultivated in more than 90 different nations. Because of the many uses for which coconut palm is suitable, it is known as the "tree of life" (Assa *et al.*, 2010). For example, while roots are utilized for healing, leaves and trunks are used as building materials. The most important part of the plant is the fruit, which can be divided into two layers: the inner layer, which is used to make cosmetic products and a variety of foods including coconut water, coconut milk, coconut shavings, coconut flour, as well as coconut oil, and the outer layer (husk), which is used to make carpets, ropes, and fibers (endosperm) (Prades *et al.*, 2012). The high quantity of saturated fatty acids (90%) in coconut oil, which are typically considered to be bad for your health, is a major factor in the numerous debates surrounding its usage in food. However, several clinical research have shown that it has a favorable impact

on both children's and adults' growth of the organism and preservation of the vital functions (Shankar *et al.*, 2013). Animals are frequently fed coconut oil blended with minced betel leaf and pepper to accelerate enzymatic activity and stimulate hunger (Barman *et al.*, 2021).

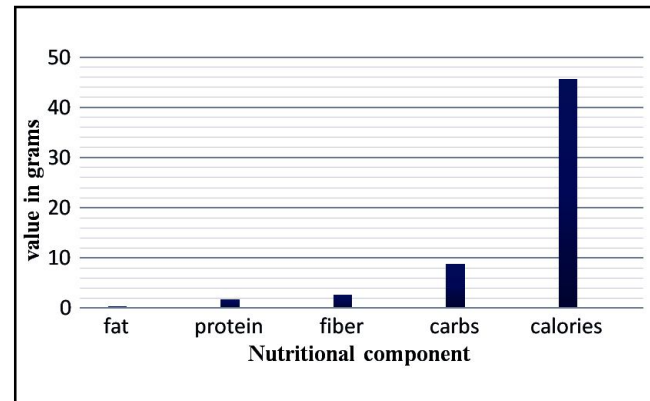


Figure 1: Nutritional facts of coconut oil.

Source: Shankar *et al.* (2013).

5.1 Effects of coconut oil on human health

5.1.1 Cancer

Cancer-related illnesses have a significant influence on global civilization (Jaworski *et al.*, 2015). Their definition includes the unregulated proliferation of altered cells that results in malignant features and restricts the growth of healthy cells within the body. (Townsend *et al.*, 2010). Additionally, coconut oil's non-promotional effects were observed in chemically caused breast cancer (Enig, 1996).

5.1.2 Cardiovascular diseases

Coconut oils are a distinct class of oil products with a high percentage of saturated fatty acids (approximately 90%), especially lauric acid (C12: 0), which is present at a level of about 50% and is referred to as lauric oils (Silalahi, 2020). Due to the presence of lauric acid, coconut oil has been proven to play a vital part in the treatment of various radio vascular illnesses, like high blood pressure as well as atherosclerosis. Additionally, it does not result in a rise in LDL levels (Vala and Kapadiya, 2014).

5.1.3 Infections

Coconut oil has antifungal, antibacterial, and antiviral effects, according to research. Its application in hospitals leads the barrier to defend against a variety of external elements (dust, fungi, bacteria, viruses). Coconut's capacity to render disease-causing microorganisms inert, including those that cause influenza, measles, hepatitis, pneumonia, urinary tract infections, even mycosis (Vala and Kapadiya, 2014).

5.1.4 Effects on children

Monolaurins is not only found in mother's milk but also in coconut oil (Silalahi, 2020). Monolaurins are essential for the development of the immune system and the ability of newborns and infants to fight off infections (Silalahi, 2020). Various researches have shown that diets containing more coconut oil promote weight gain to occur

more quickly than diets containing excess soybean oil (Jessa and Hozyasz, 2015). They observed a faster weight gain throughout a 12-month experiment with infants with low birth weights of 1250-1500 g (the number of kids on a coconut oil diet - 24) (Vaidya *et al.*, 1992).

6. Salt

Salt, often known as NaCl, is a widely accessible and reasonably priced substance. It is a fundamental need for all life and is found naturally underground as the mineral halite and as mixed evaporates in saline lakes all over the world (Feldman, 2000). In terms of dissolved solids, salt makes up the majority of saltwater. A fourth categorization of salt is salt in solution as salt brine, or solution-mined brine, which is frequently created by the end-user and is generally utilized as a feedstock for chemical manufacturing.

6.1 Aspects of health and safety

For all creatures, including humans, sodium chloride is necessary for survival. In body cells, biological fluids, and blood plasma, sodium is the main cation. Every living thing consumes it, and it is then expelled in the urine, faeces, and perspiration. Maintaining osmotic pressure, acid-base balance, and the amount of circulating bodily fluids all depend on sodium management in the body (Denton, 1982). Through, a multi-step process involving the kidneys and the adrenal glands, the sodium content of the blood and other bodily fluids is kept constant. Many illnesses, including hypertension, nephrolithiasis, asthma, stomach cancer, and osteoporosis, are thought to be triggered by dietary sodium chloride consumption (Círillo *et al.*, 1994).

6.2 Uses

Follow-up research helped isolate the active ingredient and enhance the ORS (oral rehydration salts) used to treat children who were vomiting and diarrheal, especially in rural areas (Subramoniam, 2014). Digestion is aided by consuming freshly grated garlic, ginger, and turmeric rhizome along with salt and lemon (Pushpangadan *et al.*, 2014). In baked products, salt regulates fermentation by decreasing yeast activity, preventing excessive fermentation, and helping to produce a consistent final result (Feldman, 2000). However, the major sectors include the textile and dyeing sector, where salt is used to fix dyes and standardize dye batches; metal production, such as aluminum refining, where salt is used to avoid contamination; rubber manufacturing, to split the rubber from latex; detergent processing, where salt is utilized as a filler; pigment manufacturing, as a shredding agent; ceramics manufacturing, where salt serves to vitrify hot clays; soap making, under which salt differentiates glycerol from water and rubber manufacturing (Feldman, 2000). Salt has been used in almost 14,000 distinct ways. However, the salt business normally divides the applications of salt.

7. Incorporation of flavor ingredient

7.1 Vanilla

Vanilla, the most widely used flavoring ingredient, with applications in the food and beverage, perfume, and pharmaceutical industries (Vijayalakshmi *et al.*, 2019). Vanilla has a variety of uses in the culinary, confectionery, and medicinal sectors. Additionally, it has been employed as a conventional medication. Biological actions

that have been documented include those with antimicrobial, antioxidant, antimutagenic, and antisickling properties (Sinha *et al.*, 2008). Indian processing businesses purchase green vanilla beans from farmers, process them, and then export them to overseas customers who extract the vanilla essence. Vanillin can be employed as a perfume to cover up the offensive smell from certain primary commodities (Ghazal, 2006). The presence of several elements in vanilla extract is what gives the flavour and aroma of vanilla. Some of the nonvolatile components that give vanilla its characteristic flavour include tannins, polyphenols, free amino acids, and resins (Ramachandra and Ravishankar, 2000). According to a patent, vanillin has antiultraviolet qualities that hold promise for the plastics as well as cosmetics industries (Ghazal, 2006).

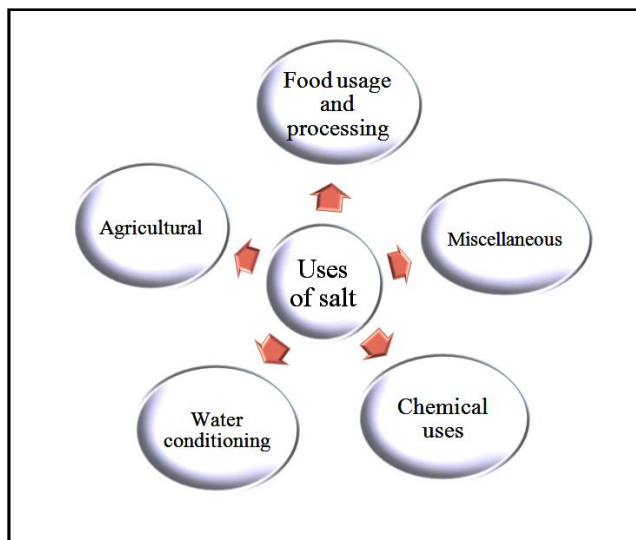


Figure 2: Uses of salt.

Source: Feldman (2000).

7.2 Cocoa essence

A dark-brown liquid chocolate extract called chocolate essence is prepared by soaking cocoa beans in alcohol. It smells strongly of chocolate. It serves as a flavour for shakes, chocolates, cakes, and cookies. Since 3.4 millennia ago, people have utilized cocoa beans, which are the fermented, roasted seeds out from fruit of the *Theobroma cacao*, or chocolate tree, as a culinary item. Theobromine, a stimulant of the central nervous system that adds to the bitter flavour of chocolate, is also present in substantial amounts in cacao and chocolate (Shea *et al.*, 2009). The flavanol epicatechin, which enters the system shortly after consuming cacao or chocolate, seems to be the most significant member of this family (Schroeter *et al.*, 2006). Blood pressure can be significantly lowered by consuming just 6 g of dark chocolate, which is only 30 calories (Taubert *et al.*, 2007).

8. Conclusion

The spread is classified as a functional spread since it has the capacity to provide several health advantages to people, particularly youths who have acquired a habit of eating spreads/butter/dips accompanying breakfast or snack foods. It is far superior to market spreads made from high fat animal sources, which are responsible for raising cholesterol levels in people. It is considered healthful

since it contains helpful nutrients. Cream, vanilla extract, salt/spices, and sweet corn are the elements used in the production. Vitamins A, B, and C, soluble fiber, plant protein, potassium, and magnesium are all abundant in sweet corn. Considering sugars to be excessive in calories, they are not employed here as sweeteners because sweet corn is already sufficiently sweet. For the scent and taste, vanilla extract is utilized to make it more palatable and enjoyable. The associated components provide a nourishing addition to the typical diet and may have advantages over commercial spreads produced from animal sources, making them an appealing dietary option. Tropical nations have a long tradition of using coconut oil. Coconut oil-rich native diets indicate that this community is generally in excellent wellness. Additional human research are required to confirm the beneficial physiological and pharmacological effects of coconut oil.

Conflict of interest

The authors declare no conflict of interest relevant to this article.

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