A REVIEW: INFLUENCE OF PROCESSING TECHNIQUES ON NUTRITIONAL COMPOSITION AND ANTINUTRITIONAL COMPONENTS OF CORN (*Zea mays* L.) KERNELS

Nur Syazana Shahabuddin[1] and Marina Zulkifli[1,2*]

[1]*Department of Food Science and Technology, Faculty of Applied Sciences, Universiti Teknologi MARA, Cawangan Negeri Sembilan, Kampus Kuala Pilah, 7200 Kuala Pilah, Negeri Sembilan, Malaysia*
[2]*Alliance of Research & Innovation for Food (ARIF), Universiti Teknologi MARA, Cawangan Negeri Sembilan, Kampus Kuala Pilah, 72000 Kuala Pilah, Negeri Sembilan, Malaysia*

**Corresponding author: marina547@uitm.edu.my*

Abstract: Corn (*Zea mays* L.) has been widely cultivated in Malaysia and it is the most prevalent cereal grains crop globally. The majority of essential nutrients can be found in the kernel parts of the corn which are edible and industrially processed to produce various kinds of food products. However, the presence of antinutritional components in the corn kernels is worrying as they can block the absorption of nutrients. Therefore, this paper aimed to review the processing techniques available in lowering the deleterious effects caused by consuming the antinutritional components such as saponin, tannin, and phytate. Boiling, roasting, fermentation, and germination are the processing techniques being studied. The findings revealed that all processing techniques done on yellow corn kernels caused reductions in the level of antinutritional components as compared to the raw corn kernels. Roasting and germination have the utmost reduction in the level of antinutritional components followed by fermentation, and boiling. Additionally, the processing techniques in enhancing the nutritional compositions are positively proven as it is believed to increase the kernels' protein digestibility, enhance the mineral extractability, and extend the shelf life of the product. Despite consuming antinutrient is reported to be risky, taking them at low concentrations may favourably give positive effects on human health. Obtained results suggested that processed corn kernels could be used in the food industry before processing them into end products. For that reason, more comprehensive research should be carried out in the future to explore the variety of other corn species, especially pigmented corn.

Keywords: Corn kernel, antinutrient, nutritional composition, processing techniques

1. Introduction

Corn (*Zea mays* L.) is also known as maize in some countries is an important annual grain that belongs to the grass family Poaceae and genus *Zea.* An ear of corn consists of an edible and non-edible part which is kernels, husk, and silks. Nowadays, there are many varieties of corn that have been grown but yellow corn is the most common cereal grain crop worldwide. Usually, the unripe corn is eaten raw or cooked, while the mature corn kernels are industrially processed to produce various kinds of products such as corn starch, corn oil, and corn flour that are used in various food preparations (Nawaz et al., 2018).

However, despite their promising nutritional significance, the seed part of corn contains some inherent antinutrients or natural toxicants, limiting their nutritive value by exerting certain deleterious effects. This antinutrients substance interferes with the absorption or utilization of minerals in corn kernels (Samtiya et al., 2020). Several studies conducted showed that levels of

tannins, phytate, trypsin inhibitor, and oligosaccharides in mung beans, cowpea, legumes and kidney bean seeds were drastically reduced after heat treatment. Hence, differing from previous research, the variable that will be reviewed is the effect of boiling, roasting, fermentation and germination towards the nutrient and antinutrient components including saponin, tannin, and phytate of the yellow corn kernels.

2. Discussion

2.1. Yellow corn kernels

Yellow corn kernel has a good source of many nutrients including proteins, carbohydrates, fats, and some of the essential vitamins and minerals. Yellow corn kernels have a huge portion of fat content which helps to hold fat-soluble vitamins A, D, E, and K that function as antioxidants and scavenge free radicals for cancer defense (Kaul et al., 2019). Besides, the fat content in the yellow corn kernel is also important because it contains about 45–50% of oil extracted from the germ in the corn kernels part. The extracted oil is beneficial in producing corn oil which can be used for cooking purposes (Kaul et al., 2019). Additionally, yellow corn kernels are high in mineral sources and also small amounts of calcium and potassium that are essential for the formation of red blood cells (Samtiya et al., 2020). Thus, it is crucial to absorb all of the nutrient content in the yellow corn kernel to get its benefit as it is only the main part that is edible and also used in industry for product making.

2.2. Effect of processing techniques on nutritional composition of corn kernels

Most processing techniques such as boiling, roasting, fermentation, and germination will affect the nutritional composition and mineral content of corn kernels due to the heat treatment and activation of enzymes. However, when comparing between types of processing techniques, roasting and germination showed a higher increment of nutrients and minerals. Roasting increased most of the nutrients and minerals except for moisture content. But, a low moisture content is a desirable phenomenon since it reduces the microbial activity of food, and increases the shelf life of food (Eleazu et al., 2021). Boiling only increases the moisture content of corn kernels due to the softening of the cell wall, allowing more water to enter the corn granule by osmosis (Eleazu et al., 2021). Meanwhile, fermentation and germination also show an increase in the mineral contents and some nutritional composition. This is due to the breakdown of complex compounds with non-digestible materials into simpler forms and make them readily bioavailable (Nkhata et al., 2018).

2.3. Effect of processing techniques on antinutritional components of corn kernels

Antinutritional components are heat labile and may be inactivated by processing techniques involving heat generation, microorganisms, and sprouting the seed. The reduction to the barest stage of these undesirable components via processing techniques is vital for lowering the antinutritional substance in the corn kernels. Both heat treatment roasting and boiling was effective in reducing saponin, tannin and phytate content in the corn kernels. Meanwhile, only activation of enzymes through germination positively reduced all of the antinutritional components including saponin, tannin and phytate. Fermentation reduced all antinutritional components except for saponin. This is due to the activation of some enzymes, resulting in decrease antinutritional

components in germinated and fermented yellow corn kernels (Nkhata et al., 2018) and heat treatment period is enough to breaks down the complex antinutrient bonds resulting in lower antinutritional components (Paterne et al., 2019).

2.4. The advantages of antinutrient-depleted foods on human health

Consuming large amounts of antinutrient food poses a health risk. Nonetheless, at low concentrations, the antinutrients may also exert health benefits. Consuming phytates in low amounts have been found to decrease triglyceride levels in the blood, as well as glucose levels after consuming starchy meals (Gemede & Ratta, 2014). Additionally, a low concentration of saponins were reported to be helpful in maintaining liver function, avoiding osteoporosis, and preventing platelet agglutination (Popova & Mihaylova, 2019). Despite this, the balance between beneficial and hazardous effects of plant bioactive and antinutrients relies on their concentration, chemical structure, time of exposure, and interaction with other dietary components (Popova & Mihaylova, 2019; Gemede & Ratta, 2014).

3. Conclusion

The study has shown that processing techniques decrease the level of antinutritional components as compared to the raw yellow corn kernels. Roasting and germination have the utmost reduction in the level of antinutritional components followed by fermentation, and boiling. Processing techniques in enhancing the nutritional compositions are positively proven to increase the kernels' protein digestibility, enhance the mineral extractability, and extend the shelf life of the product. Further research should be carried out to explore the effect of processing techniques on pigmented corn since it is rich in anthocyanins and antioxidants.

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