

Baking and Nutritional Characteristics of Adzuki Beans and Its Health impacts

Shanzay Khan *

Jinnah University for Women, Pakistan

ABSTRACT

For hundreds of years in China, the azuki bean (*Vigna angularis*) has been utilized not only as a traditional Chinese medicine, but also as a snack meal or bakery product. In Asian countries, the azuki bean is an excellent source of functional foods. Sugars, carbohydrates, proteins, fiber, polyphenols, and saponins have all been found in adzuki beans. The discovery that *Vigna angularis* is gluten-free has piqued global attention during the last decade. Adzuki beans are high in disease-fighting and health-promoting chemicals, as well as being delicious. Researchers have discovered at least 29 distinct chemicals in adzuki beans, making it one of the most nutrient-dense meals available. Adzuki beans in the form of processed products are more popular with consumers than the raw beans. Maltol is the characteristic aroma of cooked adzuki beans, which possesses a sugary flavour in baked goods. This review summarized baking impact of Adzuki beans and their pharmacological effects, such as anti-oxidative effects, hepatic protective effects, anti-diabetic effects, blood pressure adjusting effects, anti-obesity effects, and anti-cancer effects.

Keywords: Chinese Medicine, Disease-Fighting, Maltol, Pharmacological Effects, Gluten-Free

1. INTRODUCTION

Vigna angularis also known by names like azuki, azuki, and tiny red beans come in wide variety of sizes and colors. Their features vary depending on grain size and color, genetic variables, cultivar type, cultivation and harvest time, environment, and the location where they were grown. The azuki bean (*Vigna angularis* L.), belongs to Fabaceae family, and extensively found in China's north-eastern region. For thousands of years, it has been widely utilized in traditional Chinese herbal medicine, and the seed has also been consumed as a nutritious

meal in many nations [1]. Adzuki beans are abundant in proteins, lipids, vitamins, and minerals, and are a good source of carbs (55% starch). Until date, several researches have suggested that adzuki bean extracts have a variety of physiological activities, including antioxidant, anti-inflammation, atherosclerosis, anti-cancer and cardiovascular disease prevention [2]. The adzuki bean is known as the "weight loss bean" because to its low calorie and fat content, digestible protein, and abundance of bioactive chemicals. For at least a billion people, the adzuki bean is extensively utilized in a range of dishes, such as paste in pastries, sweets, cake,

porridge, adzuki rice, jelly, adzuki milk, and ice cream. Additionally, the adzuki bean is utilized in traditional medicine. Polyphenols, catechins, and chlorogenic acid are abundant. Antinutritional elements in azuki beans include phytates, -galactosides, and trypsin inhibitors, the amount of which varies depending on the cultivar [3].

The amount of protein in adzuki seeds varies depending on the seed size. Glycoproteins are the most important storage proteins in the adzuki bean. The amylose/amylopectin ratio of adzuki bean has been reported to be 34.9/65.1 and 27.9/72.1, respectively. In terms of color, swelling power, solubility, amylose concentration, and gel strength, adzuki bean starch has similar qualities to maize starch. Corn and wheat starch can be replaced with unmodified adzuki bean starch as thickeners and water-binding agents [4]. Cysteine and methionine are the limiting amino acids in adzuki bean, as they are in other pulses. The lipid fraction of adzuki beans is composed mostly of unsaturated fatty acids and presents

low contents of saturated fatty Adzuki beans have a high concentration of unsaturated fatty acids and a low content of saturated fatty acids in their lipid fraction. It contains 25% saturated fats and 75% unsaturated fatty acids. It has a minimum of 0.4 % fat and a maximum of 2.1 percent fat, which is significantly less than groundnut fat (40.1% fat). The total lipid content of the adzuki bean, on the other hand, is less than 2%. Adzuki bean has chemicals that reduce blood pressure, cholesterol, and triglyceride levels, resulting in a healthy heart [5].

Because of their health-promoting antioxidant qualities, the bioactive chemicals in the adzuki bean seed coat have attracted a lot of attention [6]. Antioxidant components in meals, such as flavonoids and tocopherols may lower the risk of heart disease, type II diabetes, and cancer. It is suggested that adzuki bean intake is connected to a lower risk of lifestyle-related illnesses in people. The isomers of tocopherols exhibit various vitamin E activity, with -tocopherol being the most physiologically active. Furthermore, because of its high resistant starch content, the adzuki bean has been proposed as an alternate diet for diabetic people [7].

The pasting characteristics of starch can be useful for determining structural characterisation and food preparation. Wheat starch was shown to be more susceptible to swelling and rupturing than azuki bean starch. It also said that it had comparable pasting abilities. Using adzuki bean flour, the combination of sour dough fermentation and legume accumulation was successful. A method for making an edible adzuki bean protein isolate from an adzuki bean protein source is described. The high purity

Table 1. The Nutrient composition of Adzuki beans

Mono Unsaturated Fat	0.05g
Poly Unsaturated Fat	0.113g
Manganese	1.73mg
Iron	4.98mg
Phosphorus	381mg
Magnesium	127mg
Vitamin B3	2.63mg
Potassium	1254mg
Zinc	5.04mg

adzuki bean protein isolates presented have desired functional properties such emulsification, water binding, foaming, and gelatin in some ways. Crumb density, texture, elasticity, coagulation, binding, moisturizing, mouth feel, leavening, foaming, creaminess, and emulsification are examples of functional characteristics. The taste based products are created with excellent protein isolates can be evaluated. For example, a batter is prepared by combining a liquid solution containing adzuki bean protein isolate with sugar, cake flour, and butter, resulting in fluffy, soft, and airy texture in cakes made with the protein isolates.

The volatile chemicals extracted from adzuki beans were divided into 11 chemical classes: aldehydes, alcohols, ketones, esters, acids, hydrocarbons, pyrazines, pyrroles, pyridines, phenols, and benzene derivatives, as well as a category of "others" that included furans and benzothiazole. Raw adzuki beans had greater amounts of aliphatic aldehydes and alcohols. Individual types of flour or mixes including both adzuki bean flour and millet flour were used to make biscuits [8]. The biscuits that were made contained the greatest levels of maltol, 2-acetylpyridine, and 2,6-dimethylpyrazine, as well as the strongest caramel-like and roasted aromas. When compared to the other biscuits, the biscuits supplemented with both adzuki bean flour and millet flour had the most caramel-like and cream-like overtones and received the highest total sensory score. The addition of grain flour may enhance the biscuit flavor's richness. We also made bread, pastries Wheat or rice flour cake glutinous rice cake baked pastry with beans.

2. DISCUSSION

For millennia, mankind have cultivated and consumed azuki (*Vigna angularis*) in different areas of the world, including China. However, adzuki's global use for human consumption has been restricted, owing to a lack of understanding about its nutritional content and the processing difficulties associated with producing adzuki-based food items. Adzuki beans are high in carbs, protein, vitamins, minerals, and fiber, as well as anti-nutritive compounds. Due to diverse extracts or specific compounds, azuki bean has a wide range of pharmacological effects. One of the most essential functions of the Adzuki bean is to balance yield, which generates a profit, with environmental and agronomic advantage. Adzuki has a similar protein composition to other common cereals like wheat, but is higher in the important amino acid lysine than other cereals [9]. Adzuki is also high in important fatty acids, fiber, minerals (particularly calcium and iron), and phytochemicals like polyphenols and phytates, thus it has a lot of promise as a functional food for disease prevention and health promotion across the world. Adzuki beans are important not only because of their appealing nutritional profile, but also because they do not contain gluten, which is found in other popular cereals such as wheat, barley, and rye. As more individuals are diagnosed with gluten sensitivity and celiac disease, the demand for gluten-free products is growing.

Unlike other legume proteins, the adzuki bean's main proteins are water-soluble rather than salt-soluble. The adzuki bean's distinctive feature of high solubility encourages the food industry to place it in an advantageous position, considering its potential applications. Total

extractable proteins, albumin, and globulins of the adzuki bean made up 21.6, 15.8, and 2.3 percent of a whole bean, respectively. In compared to other beans, azuki beans have greater levels of phosphorus, potassium, calcium, and magnesium[10].

Among seven beans, adzuki bean extract had the highest overall antioxidant activity (faba bean, broad bean, adzuki bean, red bean, pea, red lentil, and green lentil).

3. HEALTH BENEFITS

- a. *Act as a medicine*: Adzuki bean is a traditional medicine that has been used as a diuretic and antidote, and to alleviate symptoms of dropsy and beriberi in China.
- b. *Anti-microbial activity*: there was a study conducted in which the antimicrobial activity of these beans are found.
- c. *Anti-inflammatory*: Methanol extract of adzuki bean showed the inhibitory activity on the progress of atopic dermatitis- like skin lesions.
- d. *Anti-diabetic*: Glycosidase is a key enzyme involved in intestinal glucose absorption. Inhibition of alpha-glycosidasemay be a way to help reduce glucose absorption and contribute to anti-diabetes. Ethanol extract of adzuki bean exhibited the highest alpha-glycosidase inhibition activity.
- e. *Anti-cancer activity*: Heat-stable extract from adzuki bean exhibited the greatest stimulation of differentiation of bone marrow cells into immature dendritic cells of 13 edible beans. It indicated that, to prevent cancer and immunotherapy, adzuki bean extract was beneficial. The bean extract inhibited the growth of human leukemia

U937 cells and increased the induction of its apoptosis

Adzuki bean sprouts have also been discovered to be excellent carriers for *S. cerevisiae* var. *boulardii*, a probiotic that improves symptoms of antibiotic-associated diarrhea, traveler's diarrhea, and inflammatory bowel disorders [10]. Probiotics are often given to the human body via medicines or food supplements during illness, but researchers discovered another method in which adzuki beans were soaked in the inoculum and grown. In vitro, probiotic yeast was able to survive digestion. Adzuki bean and legume sprouts supplemented with *S. cerevisiae* var. *boulardii* are a new functional food product with outstanding nutritional and pro-health characteristics, as well as safety.

4. FOOD PRODUCTS

- Snacks such as bakery products (buns and pastries) filled with ann, e.g., "manju". (Wheat or rice flour cake with adzuki 'Ann' filling), "daifuku" (glutinous rice cake with adzuki 'ann' filling), "anpan" (bun with adzuki Ann filling) and "monaka" (baked pastry with adzuki Ann filling)
- Traditional confectionery, e.g., "amanatto" (whole hard candied/sugar-coated adzuki), "yokan" (firm sweet adzuki paste set with agar agar) and "mizu-yokan" (soft adzuki paste set with agar agar).
- Desserts e.g. "kakigori" (shavings of ice with sugar syrup and occasionally with sweet bean topping and a scoop of ice cream)

Red bean soup “shiruko” (sweet adzuki soup with dumplings which are small sized Rice cake/flattened cornstarch balls).

Adzuki beans in processed form are more popular with consumers than raw adzuki beans. Frying, roasting, and boiling are all common methods for heat processing beans [11]. These heat processing techniques are crucial for taste generation and inactivation of lipolytic enzymes. Maltol is the distinctive scent of cooked adzuki beans, which has a sweet taste. Biscuits are one of the most popular baked meals all over the world because of its numerous benefits, including lengthy shelf life, ready-to-eat freshness, and broad consumption.

However, refined wheat flour is the most essential ingredient in biscuits [12]. As people grow more conscious of the need of eating high-quality meals, it will become important to replace refined wheat flour with grain flour, which has a higher edible and health-care value. The taste profile is a necessary factor that influences customer acceptability. For example, research has indicated that adzuki bean and millet have potential roles in the treatment of cardiovascular illnesses and type II diabetes, respectively. The fragrance composition of biscuits can be altered by substituting beans for wheat flour [13]. According to certain research, adzuki beans contain antioxidant components and can thus be utilized as an antioxidant dietary additive. As a result, the creation of biscuits using adzuki beans has a lot of potential.

A fundamental understanding of the contributions of adzuki bean and millet flours to the volatile chemicals that contribute to the flavor of biscuits can assist food technologists

enhance both the sensory acceptability and the nutritional value of food items. Because of its high resistant starch and phenolic components, the azuki bean has been proposed as an alternate diet for diabetic people. Extrusion was recently discovered to considerably enhance the glucosidase inhibitory action of adzuki bean in diabetic mice, with the benefit attributable mostly to the rebuilt protein components following extrusion. Glucosidase, a crucial enzyme in carbohydrate digestion, has been proposed as a therapeutic target for postprandial hyperglycemia regulation [14]. A carbose inhibitor, such as glucosidase inhibitor, has been widely utilized as a therapeutic medication to reduce postprandial blood glucose levels. Food-based therapy for blood glucose management has been embraced by an increasing number of patients in recent years. The impact of extruded adzuki bean flour (EABF) for wheat flour on the qualitative characteristics of blended flour and CSB was investigated in order to improve the commercial and nutritional quality of Chinese steamed bread (CSB). The inclusion of EABF lowered the development time, stability time, and

Table 2. Mineral content in Adzuki beans

Minerals	ppm DB
Phosphorus	4787
Potassium	12915
Calcium	705
Magnesium	1530
Aluminum	11
Iron	60
Manganese	14
Zinc	35
Copper	11
Boron	13
Nickel	2

farinograph quality number of blended flours, while increasing water absorption and softening degree. With the addition, their pasting characteristics were also harmed. The EABF replacement reduced the lightness of CSB while increasing its hardness [15]. According to nutritional study, CSB with 10% and 20% EABF had greater protein and important amino acid content than Wheat Flour CSB, particularly lysine and threonine. The addition of EABF to the protein isolated from CSBs improved its glucosidase inhibitory action. It is possible to conclude that CSB with 10% and 20% EABF added might be utilized as a nutritious and healthful staple meal [16].

The ability of legumes like the adzuki bean to absorb water and soften adequately during soaking and cooking is critical for their use. For thousands of years, it has been widely utilized in traditional Chinese herbal medicine, and the seed has also been consumed as a nutritious meal in many nations [17]. Adzuki beans are a good source of carbs (55 % starch), as well as proteins, lipids, and a variety of vitamins and minerals. Adzuki beans have long been used to produce confectionary pastes in Japan. Compared with other commercial starches, adzuki bean starches have certain advantages, including non-induction of chronic disease because of the relatively low insulin response, a high paste shear resistance, and good granule stability [18-19].

5. CONCLUSION

Adzuki bean extracts have antioxidant, anti-inflammatory, anti-atherosclerosis, anticancer, and pro-cardiovascular properties. Adzuki bean quality is determined by the shade,

homogeneity, and degree of brightness of color. Adzuki bean color is determined by variety, growth circumstances, and culture method. Adzuki starch (which is comparable to starch from other beans) undergoes significant hydration and swelling of the amorphous areas when heated to a certain temperature in excess water, extending the network kept together by the intact micelles. Adzuki proteins have a high solubility (> 90%) at both acidic and alkaline pH, making them ideal for usage in liquid meals and drinks.

Because of their emulsifying, foaming, water and fat absorption, and gelling characteristics, adzuki proteins can be utilized as functional additives in meat, salad dressings, and dairy products. The moisture content of adzuki beans is heavily influenced by the relative humidity during storage.

Adzuki beans offer several health advantages, including anti-inflammatory, antibacterial, anti-diabetic, and anti-cancer properties. Adzuki bean sprouts have also been discovered to be excellent carriers for *S. cerevisiae* var. *boulardii*, a probiotic that improves symptoms of antibiotic-associated diarrhea, traveler's diarrhea, and inflammatory bowel disorders. It may be used in a variety of foods, including confectionery, bread goods, desserts, and soups. Adzuki bean has been suggested as an alternative food for patients with diabetes due to its high resistant starch and phenolic components so it concluded that we can use adzuki beans in baked products easily and it have less amount of fat while grater amount of starch.

6. ACKNOWLEDGEMENT

NA

7. CONFLICT OF INTEREST

The authors have declared that there is no conflict of interest.

8. SOURCE/S OF FUNDING

NA

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