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Research Article

Improving the Nutritional Value of Almond and Soy Milk Through Fortification with Chia and Sesame Seeds

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Abstract

The nutritional shortcomings of plant-based milk substitutes in comparison to cow's milk have been brought to light by the increased demand for these beverages due to ethical, environmental, and health concerns. Despite being common alternatives, almond and soy milk frequently lack important elements such premium proteins, omega-3 fatty acids, and specific minerals. In order to improve the nutritional content of almond and soy milk, this study investigates fortifying them with sesame (*Sesamum indicum*) and chia (*Salvia hispanica*) seeds. Following AOAC (2019) guidelines, various formulations were made with an 80:20 milk-to-seed ratio and put through proximate analysis. The findings show that fortification greatly increased the beverages' calorie, fat, and protein content. The biggest increases in protein (1.50%) and fat (4.01%) were seen in almond milk fortified with chia seeds, but soy milk with chia retained a moderate protein level and decreased carbohydrate content. Fortification using sesame seeds helped to slightly increase the mineral and carbohydrate content. According to these results, adding nutrient-dense seeds to plant-based milk can improve its overall nutritional profile and make it a good substitute for traditional dairy products for people with dietary restrictions. The study emphasises how crucial natural fortification is in filling the nutritional gap in plant-based milk and provides a cost-effective and long-term way to enhance dietary intake and public health effects.

Keywords: Omega-3 Fatty Acids; *Sesamum indicum; Salvia hispanica*

Introduction

PlaPlant-based milk, sometimes referred to as plant-based milk or dairy-free milk, is a beverage substituted for animal milk that is manufactured from plant extracts [1]. Health concerns (such lactose intolerance and cow's milk allergies), environmental sustainability ethical and lifestyle choices (like vegetarianism and veganism), and environmental considerations are some of the reasons why plant-based milk is preferred over cow's milk [2,4]. It has been stated that most unfortified plant-based milk is inadequate in supplying the necessary nutrients [1]. Although these nutrients are lacking in important nutrients, their use is increasing worldwide despite the fact that they are not supplied in truly significant levels. Plant-based milk is seen by some customers as a healthier substitute for cow's milk [3]. Because it contains vital micronutrients like vitamins and minerals along with high-quality protein, cow's milk is regarded as a complete diet [5]. In light of this, efforts should be made to lessen the nutritional disparity between cow's milk and plant-based milk, as the former has superior nutritional qualities. Since the market for plant-based milk is rising due to lifestyle choices or medical reasons, fortifying of plant-based milk is crucial to attaining this [5].

Almond milk and soy milk are well-liked plant-based milk substitutes. The goal of this effort is to fortify soymilk and almond milk with chia and sesame seeds in order to improve their nutritional value. Sesame and chia seeds were selected because they are inexpensive and provide high-quality proteins. This fortification approach may be beneficial, particularly for those who are lactose intolerant or vegan [6]. For vegans and those who are lactose intolerant, soymilk and almond milk are good sources of protein; however, they do not contain all of the required amino acids. Sesame and chia seeds were added to the problematic soy and almond milk to combat this [7]. Because it solves the nutritional deficiencies of common plant-based milk substitutes, this research has important public health and nutrition implications. For those on a vegan or lactose-free diet, fortification of almond and soy milk with chia and sesame seeds provides a practical way to increase the nutrient density of these drinks, improving dietary intake and general health results.

Materials and Methods

Research design

The benefits of fortifying almond and soy milk with chia and sesame seeds using an 80:20 milk-to-seed mixture will be investigated using a factorial design.

- Type of milk (almond and soy milk); made from *Terminalia catappa* and *Glycine max* respectively
- Type of seed (chia Seeds; *Salvia hispanica* and sesame seeds; *Sesamum indicum*) All raw materials were purchased from Utako Ultra Modern Market, Utako District, Abuja, Nigeria.

Preparation of Soy milk

Traditionally, soybeans are soaked in water for the entire night before being ground with water added while grinding to produce soymilk. The soymilk slurry can also be made using flour, grits, or full-fat flakes.

This process was used in Snyder and Wilson's 2003 study on soy milk [9]. After being washed, the 100g soy beans were steeped in water for six hours. One litre of water was used to grind the beans. The slurry that formed was boiled and stirred for 10 minutes. This heating process increases the milk's shelf life by lowering its microbial load and improving its nutritional value by neutralising trypsin inhibitors lipoxygenase and volatilising some of the off-flavour compounds that arise during grinding. To extract the non-dispersible fibre residue (okara) from the soymilk, the heated slurry is further filtered using a muslin cloth. After cooling, the soy milk was placed in the refrigerator.

Preparation of soymilk and chia seed 80:20

After being washed, the 80g of soybeans were steeped in water for six hours. After that, 20g of chia seeds were mashed with one litre of water and the beans. Boiling and stirring the resultant slurry for 10 minutes enhances the milk's nutritional content by deactivating trypsin inhibitors and lengthens its shelf life by lowering its microbial burden. To extract the non-dispersible fibre residue (okara) from the soymilk, the heated slurry is further filtered using a muslin cloth. After cooling, the soy milk was placed in the refrigerator.

Preparation of soymilk and sesame seed 80:20

After being washed, the 80g of soybeans were steeped in water for six hours. After that, the beans were ground with one litre of water and twenty grammes of sesame seeds. Boiling and stirring the resultant slurry for 10 minutes enhances the milk's nutritional content by deactivating trypsin inhibitors and lengthens its shelf life by lowering its microbial burden. To extract the non-dispersible fibre residue (okara) from the soymilk, the heated slurry is further filtered using a muslin cloth. After cooling, the soy milk was placed in the refrigerator.

Preparation of almond milk

To remove the skin, 100g of almond nuts were cooked in boiling water for one and a half minutes. After that, the nuts were crushed for five to ten minutes using one litre of water. To extract the milk, the resulting paste was placed on a muslin towel and squeezed [8]. After being brought to a boil, the milk extract was cooled and refrigerated.

Preparation of almond milk and chia seed 80:20

To remove the skin, 80g of almond nuts were cooked in boiling water for one and a half minutes. After that, one litre of water was used to grind the nuts and twenty grammes of chia seeds for five minutes. To extract the milk, the resulting paste was placed in a muslin towel and squeezed.

After being brought to a boil, the milk extract was cooled and refrigerated.

Preparation of almond milk and sesame seed 80:20

To remove the skin, 80g of almond nuts were cooked in boiling water for one and a half minutes.

After that, one litre of water was used to grind the nuts and twenty grammes of sesame seeds for five minutes. To extract the milk, the resulting paste was placed in a muslin towel and squeezed.

After being brought to a boil, the milk extract was cooled and refrigerated.

Proximate analysis

The proximate analysis was done according to the method highlighted in the Association of Official Analytical Chemists [10].

Results

Almond milk samples

The impact of adding chia and sesame seeds to almond milk on its nutritional makeup is investigated in this study. Pure almond milk (A1) had the maximum moisture level (70.54%), whereas the inclusion of chia seeds (A2) decreased moisture (66.94%) because of its high-fat content. The moisture content differed substantially ($p < 0.05$). A2 had the greatest protein content (1.50%), suggesting that chia seeds have a protein-boosting effect. Because of the omega-3 fatty acids in chia, the fat level of A2 was much greater (4.01%), whereas A3 (containing sesame seeds) had a little rise (1.95%) above A1 (1.93%). The amount of carbohydrates in each sample was comparatively constant ($p > 0.05$), with A3 having the greatest amount (27.47%). There were no discernible changes in the ash content, which represents the mineral makeup ($p > 0.05$). A2 had the greatest energy content (151.32 kcal), which was consistent with its higher protein and fat content.

Samples	Moisture content	Protein	Fat	Carbohydrate	Ash	Total energy
A1	70.54 ± 0.52c	0.72 ± 0.23a	1.93 ± 0.00a	26.58 ± 0.73a	0.24 ± 0.06a	126.51 ± 2.33a
A2	66.94 ± 0.00a	1.50 ± 0.23b	4.01 ± 0.00b	27.32 ± 0.29a	0.25 ± 0.07a	151.32 ± 0.26c
A3	69.31 ± 0.01b	1.11 ± 0.41ab	1.95 ± 0.01a	27.47 ± 0.39a	0.16 ± 0.04a	131.88 ± 0.22b

Table 1: Proximate analysis of almond milk samples.

Mean values with different superscripts in the same column are significantly different at ($p \leq 0.05$)

A1; Almond milk, A2; Almond milk and Chai Seed, A3; Almond Milk and Sesame Seeds.

Fortification with chia seeds significantly enhances protein, fat, and energy content, making almond milk a more nutrient-dense option. Sesame seeds contribute to a slight carbohydrate increase while maintaining macronutrient stability. These findings highlight the potential of chia and sesame fortification to improve almond milk's nutritional value, catering to diverse dietary needs.

Samples	Moisture content	Protein	Fat	Carbohydrate	Ash	Total energy
B1	63.82 ± 0.03a	2.67 ± 0.23a	1.42 ± 0.01c	31.63 ± 0.29c	0.47 ± 0.11a	149.11 ± 1.83c
B2	68.13 ± 0.01b	2.67 ± 0.11a	1.13 ± 0.00b	27.68 ± 0.19b	0.40 ± 0.10a	131.53 ± 0.44b
B3	69.25 ± 0.01c	2.60 ± 0.30a	1.02 ± 0.00a	26.83 ± 0.35a	0.30 ± 0.07a	126.91 ± 0.27a

Table 2: Proximate analysis of Soy milk samples.

Mean values with different superscripts in the same column are significantly different at ($p \leq 0.05$).

B1; Soy milk, B2; Soy milk and Chai Seed, B3; Soy Milk and Sesame Seeds.

Soy milk sample

The soy milk samples' moisture, fat, carbohydrate, and total energy content varied significantly ($p \leq 0.05$) among formulations, with pure soy milk (B1) having the lowest moisture content (63.82%), the highest carbohydrate (31.63%), and the highest energy values (149.11 kcal). Fortification with sesame seeds (B3) and chia seeds (B2) increased moisture content to 68.13% and 69.25%, respectively, while lowering carbohydrate levels. The protein concentration (~2.6–2.7%) was consistent across all samples. The fat level dropped with fortification, especially in B3 (1.02%), and was greatest in B1 (1.42%), most likely as a result of variations in lipid composition. Similar patterns were seen in total energy, with B1 having the highest caloric content (149.11 kcal), followed by B2 (131.53 kcal) and B3 (126.91 kcal).

These results suggest that the macronutrient composition of soy milk is changed by chia and sesame seed fortification, which may make it more suited for particular dietary requirements. Chia-enhanced soy milk (B2) keeps its moderate calorie level and greater protein content. On the other hand, consumers wanting a variety of nutritional advantages have alternatives thanks to sesame-fortified soy milk (B3), which lowers fat and energy levels.

Conclusion

This study sought to address these nutritional inadequacies by incorporating chia and sesame seeds into almond and soy milk, two popular plant-based dairy alternatives. Even while soy and almond milk have many benefits, especially for vegans and those who are lactose intolerant, they usually lack essential elements including high-quality protein, omega-3 fatty acids, and some micronutrients that are abundant in cow's milk. The study's findings show that the nutritional profile of plant-based milk replacements is enhanced by the addition of chia and sesame seeds. Compared to its unfortified cousin, chia seed-fortified almond milk exhibited the greatest improvement in terms of fat and protein content, making it a more nutrient-dense beverage. From a broader perspective, this study highlights how important it is to support plant-based foods in order to meet the growing global demand for nutrient-dense, sustainable alternatives to animal-based goods. More individuals are switching to plant-based diets due to ethical, environmental, and health concerns, so it's important to make sure these alternatives are nutrient-dense in addition to being practical. Fortification using natural ingredients like chia and sesame seeds offers a convenient and reasonably priced option to achieve this for both producers and consumers.

Bibliography

1. Sethi S., *et al*. "Plant-based milk alternatives an emerging segment of functional beverages: a review". *Journal of Food Science and Technology/Journal of Food Science and Technology* 53.9 (2016): 3408-3423.

2. Siddiqui SA., *et al*. "Plant-Based Milk - Thoughts of Researchers and Industries on What Should Be Called as ´milk'". *Food Reviews International* (2023): 1-28.

3. Jeske S., *et al*. "Past, present and future: The strength of plant-based dairy substitutes based on gluten-free raw materials". *Food Research International* 110 (2018): 42-51.

4. Jeske S., *et al*. "Evaluation of physicochemical and glycaemic properties of commercial plant-based milk substitutes". *Plant Foods for Human Nutrition 72* (2017): 26-33.

5. Antunes I C., *et al*. "Cow's Milk in Human Nutrition and the Emergence of Plant-Based Milk Alternatives". *Foods* 12.1 (2022): 99.

6. Ramsing R., *et al*. "Dairy and Plant-Based Milk: Implications for Nutrition and Planetary Health". *Current Environmental Health Reports* 10.3 (2023): 291-302.

7. Ashura K., *et al*. "Nutritional, health benefits and usage of chia seeds (Salvia hispanica): A review". *African Journal of Food Science* 15.2 (2021): 48-59.

8. Aydar E F., *et al*. "Plant-based milk substitutes: Bioactive compounds, conventional and novel processes, bioavailability studies, and health effects". *Journal of Functional Foods* 70 (2020): 103975.

9. Snyder H and Wilson L. "Soy (soya) beans Processing for the food industry". In Elsevier eBooks (2003): 5383-5389.

10. Association of Official Analytical Chemists (AOAC). Official Methods of Analysis of AOAC International (21st ed.). AOAC International (2019).