

Proximate Analysis and Fiber Content of Smoothies Fortified with Chia Seeds

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Abstract

Consuming adequate intake of fiber from fruit and vegetable is important to prevent metabolic disease. However consumption of fruit and vegetable in Indonesia still less than recommendation. Smoothies fortified with chia seeds has been develop to help achive adequate intake of fruit and vegetable. The objection of this study was to investigating proximate analysis and fiber content of smoothies fortified with various amount of chia seed (0 g, 2.5 g, 5 g and 7.5 g). This was a quantitative study with experimental design using four treatments. Proximat analysis performed with Gravimetry, Kjedahl, Soxhlet method for water and ash content, protein and lipid content. Carbohydrate content was test using by difference method. The addition of chia seeds increased the level of crude protein, lipids, carbohydrate and dietary fiber. Fortification of chia seeds in smoothies has improved nutritional content in our product and it became alternative ways to provide adequate intake of dietary fiber.

Introduction

Metabolic disorder occur when normal body's process are disrupted by various factors resulting in dysfunction including atherogenic dislipidemia, hypertension, obesity and insulin resistance.¹ People with this dysfunction have greater risk for developing metabolic disease including cardiovascular disease and diabetes, which are the most common cause of global death² including Indonesia. Cardiovascular disease is the main cause of death in Indonesia and around 15% death caused by the other non-communicable disease.³

Dietary habits known as one of the important behavioral factor of metabolic disease beside obesity and physical inactivity.¹ Several study suggest that dietary pattern characterized by low consumption of vegetable, fruit and fiber are associated with risk of developing metabolic disease.⁴ Consumption of fruit and vegetable in

Indonesia still less than recommendation.⁵ The recommendation of daily intake of fruit and vegetable is 400 grams per person while fiber intake recommendation based on AKG 2019 is 30 grams per day.⁶ Study showed that about 97.1% Indonesian people consuming less fruit and vegetable especially for adolescent and adult.⁷

Indonesia has various biodiversity potential including fruit and vegetable as a source of fiber. Consumption of fruit and vegetable as a smoothie is an excellent and convenient way to provide adequate intake of fiber. Smoothies have been mostly encouraged as beverage option for well-being and healthy lifestyle.⁸ Smoothies are usually semi-liquid, thick beverages obtained by blending fruit, fruit juice and or fruit puree. Smoothie contains either whole or different parts of fruit and vegetable and not separating fiber and juice, thus it will increasing the nutritive properties.⁹ Recently, consumption of smoothies is often added with chia seeds. Chia seeds has been increasingly recognized and received scientific attention.¹⁰ This plant is native to Central America spesifically Mexico and Guatemala. In 2009 chia seeds were approved as a new food source and the used chia seeds was reported as safe because it has no side effects.¹¹ Chia seeds contain 36-40 grams fiber per 100 gram which is equivalent to the daily intake recommendation of fiber for adults.¹² Several study shown that chia seeds lowering trigliseride and blood glucose level, postpandrial blood glucose, total cholesterol and blood pressure¹³⁻¹⁶ Another study also shows that the addition of 15-20% chia seeds flour was able to increase total fiber and reduce the glycemic index in the product formulation.¹⁷ The combination of fruit and vegetable as smoothies fortified with chia seeds is well known but has not widely studied. Therefore we formulated smoothies fortified with chia seeds to investigating proximate analysis and fiber content of the product.

Materials and Methods

This was a quantitative study with experimental design using four formulation of smoothies fortified with chia seeds. Smoothies formulation using ingredient fruit and vegetable including carrot, strawberry, apple, banana, orange juice, sugar and chia seeds fortified with various amount of chia seeds (0 gram, 2,5 gram; 5 grams and 7,5 grams).

All of the materials were thoroughly washed in clean water, peeled and cut open and the seeds were removed. The cut fruit and vegetables were weighed based on the

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formulation shown in Table 1 using electronic weighing balance. An amount of 100 ml of orange juice was obtained by squishing about three to four oranges. This smoothies was added with 5 grams of sugar each formulation. All of those materials were blend using electric blender for 60 second to obtain smoothies. Each smoothies then were added by chia seeds based on formulation and stirred well as shown in Figure 1.

The Proximat analysis performed with gravimetry, Kjedahl, Soxhlet method for water and ash content, protein and lipid content. Carbohydrate content was tested using by difference method. Fiber content was performed using reflux method. Data was Analysed with univariate analysis to

investigating proximate and fiber content each formulation of smoothies with addition of chia seeds.

Results

Proximate analysis performed in this study including water, ash, protein, lipid, carbohydrate and fiber content. Based on the result of proximate analysis, it is shown that water content of smoothies was decreasing as addition of chia seeds. F1 without chia seeds added has 86.70% water content, while F2 has 85.5% water content, F3 has 84.69 water content and F4 has 84.04% water content. The highest water content was found in F1 without chia seeds added and the lowest water content was found in F4 with 7.5 gram chia seeds added. This study showed that ash content in F1 was 0.31%, F2 was 1.2%, F3 was 2.04% and F4 was 0.45%. Ash content in smoothies formulation show the highest was at F3 with 5 gram chia seeds added and the lowest ash content was found in F4 with 7.5 chia seeds added. Protein content in this study performed with Kjeldahl method. Protein content in this study show the different result with water content. Water content was decreasing as chia seeds added but the protein content was increasing as chia seeds added into smoothies. F1 has 0.46% protein content while F2 has 0.54% Protein content, F3 has 0.56% protein content and F4 has 1.06% protein content. The highest protein content found in F4 with 7.5 gram chia seeds added while the lowest protein content found in F1 without chia seeds added. The addition of 2.5 gram chia seeds each formulation increasing an average of 0.2% or protein content. Addition of chia seeds also increasing lipid content of smoothies. It shown in Table 2 that F1 has 0.12% lipid content, F2 has 0.58% lipid content, F3 has 1.07% lipid content and F4 has 1.43% lipid content. The addition of 2.5 gram chia seeds each formulation increasing an average of 0.44% lipid content of smoothies, with the highest lipid content found in F4 with 7.5gram chia seeds added and the lowest lipid content found in F1 without chia seeds added. The carbohydrate content of smoothies showed different result, the highest carbohydrate content found in F4 but lowest carbohydrate content found in F3 with addition 5 grams of chia seeds. It showed that there was decreasing of carbohydrate content when 5 grams chia seeds added compared to the other formula with chia seeds added. Fiber content has also increasing as chia seeds added. F1 has 10.93% fiber content, F2 has 12.59% of fiber content, F3 has 20.67% fiber content and F4 has 26.57%

fiber content. The highest fiber content found in F4 with 7.5 gram chia seeds added and the lowest fiber content found in F1 without chia seeds added. The addition of 2.5 gram chia seeds each formulation increasing an average of 5,21% of fiber content.

Discussion

Smoothie is a non-alcoholic liquid drink that made out of fresh or frozen fruit or vegetables. It is an excellent and convenient substitutes which promotes the intake to fresh fruit and vegetables on daily basis.¹⁶ The mixing of a few fruit and vegetable allows obtaining not only a sensory-attractive product but also with more beneficial health promoting values.¹⁷ In this study, our smoothies made up from fruit and vegeta-

bles including carrot, strawberry, apple, banana and orange juice. Beside those fruit and vegetables, our study used chia seeds that added into the smoothies. Our study showed that chia seeds added was increasing nutrient content of the smoothies. Addition of chia seeds each formulation of smoothies was increasing protein content of the smoothies. Protein represent <1% of the fresh mass of most fruit and vegetable tissue,¹⁸ while addition of 2.5 gram chia seeds increasing an average of 0.2% or protein content of smoothies. Previous study showed that chia seeds contain about 19.6% protein and it was higher compared with other seeds.¹⁹ It also reported greater than other grains, such as wheat, barley, oats, corn, and rice,²⁰ Chia seeds contain all essential amino acids for human nutrition including isoleucine, leucine, methionine, phenylalanine, lysine, threonine, histidine,

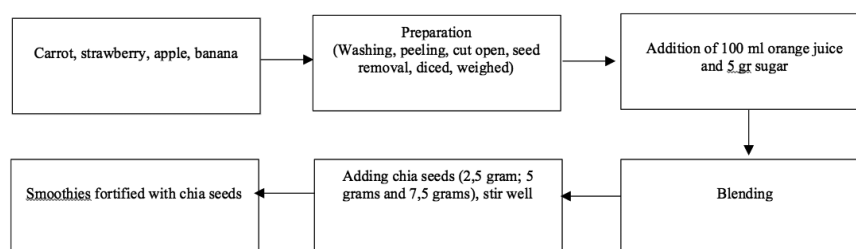


Figure 1. Production of smoothies fortified with chia seeds.

Table 1. Formulation of four treatment smoothies fortified with chia seeds.

Ingredient	F1	F2	F3	F4
Chia Seeds	0 g	2,5 g	5 g	7,5 g
Carrot	25 g	25 g	25 g	25 g
Strawberry	50 g	50 g	50 g	50 g
Apple	50 g	50 g	50 g	50 g
Banana	50 g	50 g	50 g	50 g
Orange Juice	100 ml	100 ml	100 ml	100 ml
Sugar	5 g	5 g	5 g	5 g

Table 2. Proximate analysis and fiber content in four formulation of smoothies fortified with chia seeds.

Nutrient	Formulation, %			
	F1	F2	F3	F4
Water content	86.70	85.50	84.69	84.04
Ash content	0.31	1.2	2.04	0.43
Protein	0.46	0.54	0.56	1.06
Lipid	0.12	0.58	1.07	1.43
Carbohydrate	12.41	12.17	11.64	13.05
Fiber	10.93	12.59	20.67	26.57

tryptophan and valin. Glutamine is the highest concentration of amino acid in chia seeds.²¹ The literature revealed the presence of amino acid in chia in appreciable amount. Food rich in protein had a great effect on weight loss due to the loss of fats in the body. The result of study revealed that intake of protein about 25% of the total energy has consequence in significant fat loss. The regular intake of chia may help the overweight men and women to lost weight.²²

Lipid content in smoothies was also increased as chia seeds added. The highest lipid content was found in F4 which was added by 7.5 gram chia seeds however plant-derived food do not contain significant amounts of cholesterol.¹⁸ Chia seeds were ascribed high nutritive value due to their high contents of lipid. Chia seeds contain on an average 30.74% of total lipids. The fatty acid profile chia seeds were of particular interest. Chia seeds have high content of polyunsaturated fatty acids, mainly alpha-linolenic acid (ALA), about 60% all fatty acids. Linoleic, oleic and palmitic acids were found in lower amounts. Chia seeds also have greater contents of omega-3 acids than flaxseeds.²² Previous study showed that consumption of 7.3 grams chia seeds per day provide 100% of the recommended intake of omega-3 fatty acids, which preventing from chronic diseases. Chia seeds considered as a natural source of omega-3 that play important role in health due to its anti-inflammatory, antiarrhythmic and antithrombotic activity.²³ Another study also shows that proportion of omega-3 or omega-6 from chia seeds oil was 3.57 which was greater than most vegetable oils including canola oil, soybean oil, and olive oil. Chia seeds can be considered a functional food because it was a source of omega-3 fatty acid at least 0.1 grams of omega-3 in 100 grams product.¹⁹

Fruit and vegetables are good sources of fiber. It contributed 37.1% of the fiber in the food supply followed by grain products and legumes.¹⁸ This study showed that fiber content in smoothies made from fruit and vegetable was 10.93%. Addition of chia seeds improved fiber content of smoothies. Amount of 2.5 gram chia seeds added each formulation increasing an average of 5.21% of fiber content of the smoothies. According to the previous study, the content of fiber in chia seeds is 23-41%, where the insoluble fraction makes about 85% and the soluble fraction makes about 15%.²⁴ The content of fiber in chia seeds depends on the region cultivation and climate. Chia seeds contain about 4-5 times more than almonds, amaranth, quinoa and soy and twice as much fiber as bran.²⁵ Another study showed that

total dietary fiber content of chia seeds range from, 36-40 grams per 100 grams which was higher than that present in several grains, vegetables and fruit such as corn, carrot, spinach, banana, pear, apple, kiwi.^{24,26} Insoluble and soluble dietary fiber content of chia seeds around 23-46% and 2.5-7.15% respectively.²⁷ Consumption adequate intake of fiber play important role in preventing and treating of various disease including circulatory system, diabetes, and also metabolic disease.²⁶

Water content analysis showed different result with protein, lipid and fiber content. It showed that water content was decreased as chia seeds added into the smoothies. the lowest water content was found in F4 which amount of 7.5 grams chia seeds was added. Decreasing of water content each formulation as chia seeds added showed that chia seeds has absorbing properties. Chia seeds has ability to form a gel layer. This gel layer form after the seeds are hydrated with water. Outer part of the epidermis immediately absorbs water and form a gel layer and form transparent capsule. This transparent capsule secretes gum that hold and absorb water. It provide a various viscosity based on concentration chia seeds given. Chia seeds absorb up to 12 times its dry weight.²⁸

Conclusions

Fruit and vegetable are an essential part of the human diet because it rich source of dietary fiber and another nutrition. Consuming adequate intake of fruit and vegetable play vital role in health promotion and prevention of certain disease including metabolic disease. Smoothies produced from carrot, strawberry, apple, banana, orange juice and chia seeds can be considered valuable product as a source of great nutrient for daily basis. This study revealed that combination of fruit, vegetable and chia seeds increased content of protein, lipid and dietary fiber of smoothies. Consuming smoothies contain of fruit and vegetable added by chia seeds will provide alternative way to meet nutritional daily requirement and also preventing from metabolic disease. More research is needed to explore another nutrient content of this product including antioxidant and micronutrient that will give health benefit from preventing disease and meet nutritional requirement.

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