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A Quality and Economic Analysis of Non-fermented Chocolate Seeds, Young Surian Leaves, and Ginger on Chocolate Drink Formulas

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Abstract. This study aims to obtain beverages that meet the quality requirements of chemical, microbiological, and sensory properties from a combination of non-fermented cocoa beans, young surian leaves, and ginger as natural ingredients widely available in Indonesia and to analyze the product's financial feasibility. Sensory properties were analyzed using the hedonic scale method to find the best formula. The ANOVA test has shown that the beverage formulas have no significantly different aroma and flavor (the sig. (P) > 0.01) but have significantly different colors and appearance (the sig. (P) < 0.01). The chocolate drink has a quality of chemical, microbiological, and sensory properties; thus it potentially becomes a beverage rich in antioxidants. The financial feasibility analysis results agree with the BEP, NPV, Net B/C, and PBP and express that the beverage business is potentially conducted.

Keywords: chocolate drinks, economic analysis, ginger, instant drinks, surian leaves

1. Introduction

Indonesia, after the Ivory Coast and Ghana, is the world's third-largest cocoa producer, accounting for 713,378 tons in 2020 [1]. Because Indonesian cocoa products are still managed traditionally (85% of national cocoa bean output is not fermented), Indonesian chocolate is recognized as having poor quality in grades 3 and 4. The price of Indonesian cocoa beans and goods in the international market is extremely low due to their poor quality with a discount of USD200/ton or 10% -15%.

Extraction and utilization of cocoa butter as well as a study on the potential of flavonoid bioactive components in non-fermented fat-free cocoa powder as antioxidants in the human body have been conducted to investigate the potentials of non-fermented local cocoa. Non-fermented fat-free cocoa powder is a low-quality product that has not been commonly employed in cocoa processing and has a polyphenol level of 4.43 g/100 g [2]. Fat-free cocoa powder from Indonesian farms can boost the body's enzymatic defense mechanism against free radical assaults [3]. Fat-free *lindak* cocoa powder could boost antioxidant capabilities of erythrocyte cells [4].

According to [5], the composition and high polyphenols components in cocoa beans have changed throughout several processes, such as fermentation, drying, and roasting. Cocoa powder is generated by reducing the process of cocoa beans, specifically non-fermented and non-roasted cocoa beans. This powder can be used as raw material to produce chocolate beverages; however, the powder results in a bitter astringent beverage with a minor odor.

A bitter flavor in chocolate beverages will probably affect customer approval. To lessen the bitterness of chocolate beverages, the researchers tried to combine non-fermented cocoa beans with young surian leaves. This research aims to identify a chocolate drink formula that combines non-



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fermented cocoa beans, young Surian leaves, and ginger to produce a drink preferred by customers and compute the financial feasibility analysis of instant chocolate drinks based on one of the best formulas.

2. Methodology

The study was conducted at the Laboratory of Organic Chemistry of Natural Materials in the Faculty of Mathematics and Natural Sciences of Universitas Andalas and at the Sensory Assessment Laboratory Politeknik Pertanian Negeri. Mature lindak cocoa was collected from Rambatan sub-district, Tanah Datar district. Meanwhile, young surian leaves were collected from Limo Kaum sub-district, Tanah Datar district. Fresh ginger and granulated sugar were utilized in this investigation. The instruments of this research were a Blender, sieves with various mesh sizes, a beaker glass, digital analytical balance, scales, a measuring cup, beakers with various sizes, an electric bath or hot plate, a glass stirrer, Whatman filter papers, and sensory property testing equipment.

Research stages

The first stage was creating beverage formulas and sensory evaluation. The second stage making instant drinks using the foam-mat drying method from three formulas chosen for their best sensory properties values. The third stage was analyzing the financial feasibility of the best instant drinks, which included basic costs, NPV, Net B/C, BEP, IRR, and PPB.

This investigation adopted a totally randomized design with factorial A x B. Factor A was the variation of powdered young surian leaves (1.5, 2.0, and 2.5 grams) while Factor B was the variation of non-fermented cocoa powder (0, 0.1, 0.3, and 0.5 grams). This investigation resulted in 12 different treatments/formulas, each of which was repeated three times. These 12 formulas were A₁B₀, A₁B₁, A₁B₂, A₁B₃, A₂B₀, A₂B₁, A₂B₂, A₂B₃, A₃B₀, A₃B₁, A₃B₂, and A₃B₃. The data were analyzed using the SPSS software and one-way analysis of variance (ANOVA). Duncan's test was also employed to evaluate the mean differences of each treatment. A statistically significant difference was then defined as a P-value or sig less than 0.01.

3. Result and Discussion

The hedonic approach was used to examine the sensory properties of chocolate beverages. Six of twelve chocolate drink formulas were chosen by considering their potential as an antioxidant-rich beverage and appealing sensory properties. The sensory properties were tested using a panel of 28 participants. Figure 1 summarizes the results of the sensory properties testing.

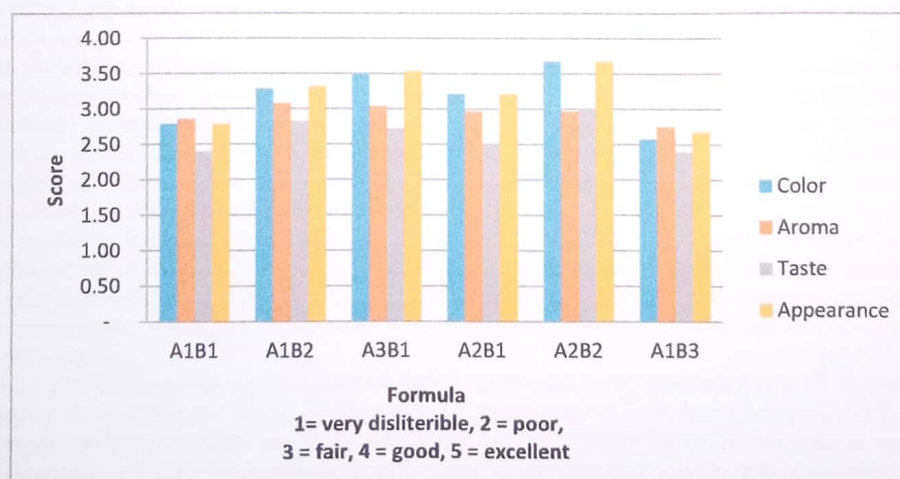


Fig. 1 Sensories values of colors, aromas, tastes, and appearance of chocolate drinks

The color and appearance of the six drink formulas have reached the sig (P) 0.01 value on the ANOVA table of sensory property test. This indicates that the formulations have statistically and significantly different colors and appearances.

Duncan's additional test has yielded three color groups of drink formulas: group 1 consists of A₁B₂, A₃B₁, A₂B₁, and A₂B₂; group 2 consists of A₃B₁, A₂B₁; group 3 consists of A₁B₁ and A₁B₃. Furthermore, the test has revealed three appearance groups of drink formulas: group 1 consists of formula A₁B₂, A₃B₁, A₂B₁, and A₂B₂; group 2 consists of formula A₁B₁, A₁B₂, and A₂B₁; group 3 consists of formula A₁B₁, A₂B₁, and A₁B₃. The beverages' different colors and appearances are caused by the mix of components. Table 1 shows the sensory test results of six chocolate drink recipes.

Table 1. Sensory test results of chocolate drinks

Sample names	Colors	Aromas	Tastes	Appearances
A ₁ B ₁	2.79 bc	2.86 a	2.39 a	2.79 bc
A ₁ B ₂	3.29 a	3.07 a	2.82 a	3.32 ab
A ₃ B ₁	3.50 ab	3.04 a	2.71 a	3.54 a
A ₂ B ₁	3.21 ab	2.96 a	2.50 a	3.21 abc
A ₂ B ₂	3.68 a	2.96 a	3.00 a	3.68 a
A ₁ B ₃	2.57 c	2.75 a	2.39 a	2.68 c

*) Numbers followed by the same lowercase letters are not substantially different at the 1% level.

Duncan's test has revealed that the formulas have no statistically significant differences in aroma and taste (sig. (P) > 0.01). However, the panelists gave the highest score of aroma to the A₁B₂. The panelists gave the lowest average score to the taste of drink formulas (below or equal to 3) because the drink formula of unusual flavor is bitter even after the sugar solution has been added.

Not all bitter sensations are avoided as beer, coffee, chocolate, and tea are exceptions. Experts and aficionados of these items argue that the bitter taste provides a unique flavor that, if removed, would limit the enjoyment. Only micromole levels of the bitter flavor components may be perceived by the human sense of taste. Bitterness perception is influenced by a number of factors, including age and gender. Humans' sensitivity to bitter tastes reduces as they grow older. Women are more responsive to fundamental taste sensations than males. In addition, culture and habits have an impact on sensitivity. Bitter inhibitors, enzyme treatments to break down bitter taste components, and binding/capturing bitter taste components in goods are only a few of the developed approaches to minimize bitter flavor in food items.

The researchers have used surian leaves to lessen the bitterness of papaya leaves in the preparation of wet papaya noodles. The more surian leaves used and the longer the boiling procedure, the greater organoleptic acceptability of papaya wet noodles is [6]. Unlike the chocolate drink formula using surian leaf powder, formula A₁B₃ has received the lowest rating (highly disliked) when surian leaf was added at the maximum concentration (22.7%). Formulae A₁B₂, A₂B₂, and A₃B₁ have higher scores of taste and scent than for other formulations.

Surian leaves have a different influence on the two food items: wet papaya noodles and prepared chocolate drinks. This influence might be attributed to changes in the processing of the components. Wet papaya noodles do not employ boiling water from papaya leaves and surian (discarded) in the production process although steeped water is used to produce chocolate beverages rich in polyphenols and antioxidants.

Cocoa powder includes 1.5-3% of theobromine. Bitterness is the inherent flavor of chocolate, and this flavor derives from the chemical theobromine. People do not completely comprehend the nature and distinction between bitter and astringent tastes; hence the bitter flavor of chocolate is sometimes misinterpreted with the astringent taste. Furthermore, the tannins and polyphenols in chocolate are the components that give astringent and bitter flavor, which diminishes the sensory value of food or drink. A bitter taste may be created by adding surian leaves to boost the sensory value in the production of wet noodles from papaya leaves containing karpain alkaloids [6].

Furthermore, unlike papaya wet noodles, alkaloids in chocolate beverages did not decrease. There was a mass transfer of alkaloids from papaya leaves to surian leaves. The boiled water of papaya and suren leaves was not used in a subsequent process, but the steeped water was used to make chocolate drinks, which have high polyphenols and antioxidants [6]. This explains why the panelists perceived a bitter taste in the drink formulas. The bitter flavor components can only be perceived by the human sense of taste in micromoles.

Three chocolate drink formulas, A₁B₂, A₃B₁, and A₂B₂, were chosen to manufacture instant drinks by considering the results of the sensory test. The foam-mat drying process was used to make instant beverages. Maltodextrin was employed as a filler while egg white was used as an emulsifier. The formula A₂B₂ was picked as the finest instant drink. Table 2 shows the drink properties of the A₂B₂ formula in detail.

Table 2. Characteristics of A₂B₂ instant drink

Analysis results	Values
Yield (% w/w)	66.45
Antioxidant activities (% inhibition)	22.71
Proxymate analysis	
Water content (%)	10.92
Ash content (%)	0.97
Fat level (%)	1.87
Protein content (%)	8.19
Carbohydrate content (%)	78.05

An economic analysis was carried out to examine the feasibility of producing instant drinks as a business opportunity. To find a comprehensive measure as the basis of accepting or rejecting a project or business, investment criteria were set. The investment criteria used in this research are the break-even point, net present value, internal rate of return, net benefit-cost ratio, pay-back period, and sensitivity analysis [7].

Fixed and variable expenses make up the fundamental costs (production costs). Meanwhile, the labor pays, depreciation, equipment upkeep, promotion, and marketing are all fixed expenditures. Labor salaries, raw materials, auxiliary materials, gasoline, power, and packaging prices are examples of non-fixed costs (variable costs).

Space rental fees, land and building tax, promotions, permits, depreciation of equipment, equipment maintenance, promotions, and management pay are fixed costs to create instant powder beverages. The annual total fixed cost is IDR35,859,200.00. Meanwhile, the maintenance costs account for about 10% of the overall cost.

Labor wages, raw materials, auxiliary materials, gasoline, power, and packaging charges are the components of variable costs. With full production capacity, the annual total variable cost is IDR951,982,500.00 (100%). At a full manufacturing capacity, the annual cost of instant powder drinks is IDR987,841,700.00, and the plant produces 79.74 kg or 5316 sachets of powdered beverage per day. The starting price of instant drink powder is IDR41,294.28 per kilogram or IDR619.41 per sachet.

A break event time (BEP) is a point in a business's production cycle when the business does not generate a profit and lose money, or when the profit and loss are equal. The annual BEP for instant drinks is 347,908.03 sachets or 1,159.69 sachets per day (100% of the capacity).

The difference between the present values of revenues (benefits) and expenses (costs) at a certain interest rate is known as a net present value (NPV). The job is viable if the NPV is larger than zero; otherwise, the work is not feasible. The NPV in the powdered beverage industry was IDR16,411,434.47. A positive NPV value implies that the company is feasible. Profit, loss, and cash flow predictions are created before computing the NPV.

The benefit-cost ratio (B/C Ratio) compares the benefits gained with the expenditures spent or positive net present values with negative net present values (NPV). If a company's net B/C value is more than one, it is considered feasible; if it is less than one, it is considered impracticable. The net B/C value of the powder drink business is 1.07, indicating that it is viable to operate.

The internal rate of return of instant drinks was determined using the finance tool IRR in Microsoft Excel. The beverage powder company has 14% of the internal rate of return. If the IRR number exceeds the bank's interest rate, a project or industrial activity is considered viable. The bank interest rate is 18%; thus, the IRR value is less than the bank interest rate, indicating that the project is not feasible from an IRR standpoint. The instant beverage firms have a payback period of 3.33 years (3 years and 4 months).

4. Conclusion

The chocolate drink was composed of 12 different formulas and treatments. The sensory property evaluation on chocolate drinks has revealed that the formulas have no statistically significant different aroma and taste. In contrast, they have statistically significant color and appearance. The alkaloids in chocolate beverages are responsible for the bitter flavor. The addition of young surian leaf powder to chocolate drinks does not change the bitterness of the drink but raises the total phenol and antioxidant activity.

The business feasibility analysis using the instant drink formula A2B2 discovered the BEP value of 347,908.03 sachets or IDR243,535,620.82, the NPV of IDR16,411,434.47, the Net B/C of 1.07, the PBP of 3.33 years, and the IRR of 14%. According to the investment feasibility criterion, the instant beverage industry is worthwhile to pursue.

Suggestions

This study suggests that further studies add another component, like milk, in non-fermented chocolate beverages to improve the sensory property assessment of beverage flavor.

References

- [1] Direktorat Jenderal Perkebunan, "Produksi Kakao Menurut Provinsi di Indonesia 2017-2021," 2021.
- [2] S. Z. Zairisman, F. Zakaria, and B. P. Priosoeryanto, "Potensi Imunomodulator Ekstrak Bubuk Kakao Bebas Lemak sebagai Produk Substandar secara in vitro pada Sel Limfosit Manusia," 2006.
- [3] F. Hasanah, "PENGARUH MINUMAN BUBUK KAKAO LINDAK BEBAS LEMAK TERHADAP AKTIVITAS ENZIM ANTIOKSIDAN DAN ENZIM DETOKSIFIKASI PADA ERITROSIT DAN PLASMA MANUSIA," Institut Pertanian Bogor, 2007.
- [4] Erismar Amri, "Pengaruh konsumsi minuman bubuk kakao lindak bebas lemak terhadap sifat antioksidatif eritrosit manusia," Institut Pertanian Bogor, 2007.
- [5] J. Wollgast and A. Elke, "Review on polyphenols in Theobroma cacao: changes in composition during the manufacture of chocolate and methodology for identification and quantification," *J.Food Res. Int.*, vol. Volume 33, no. Issue 6, July 2000, p. Pages 423-447, 2000.
- [6] S. Putri, "Pengaruh Penambahan Daun Surian (Toona sureni Merr) dan Lama Perebusan Daun Pepaya (*Carica papaya* L.) terhadap kualitas Mie Basah daun Pepaya," Universitas Andalas, 2012.
- [7] C. Grey, P. Simanjuntak, L. K. Sabur, P. F. L. Maspaitella, and R. C. G. Varley, *Pengantar Evaluasi Proyek*. Jakarta: Gramedia Pustaka Utama, 1993.