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New product development for mixed beverages of Aceh robusta coffee and cocoa

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Abstract: Aceh Province is known by the central production of not only Gayo coffee but also Robusta coffee. They are produced on the southwest coast and east coast for cocoa commodities. Meanwhile, there have been changes in lifestyles, especially in the millennial generation, including at Aceh Province. To reach the opportunity it is very urgent to realise a new product development based on beverages. Focuses of this research were to obtain a coffee-cocoa blend formulation that is suitable for consumers and economical to develop by agroindustry. The design of experiments was formulated for an Aceh Robusta coffee-cocoa mix with percentages of 20:80, 40:60, 60:40, and 80:20. The hedonic analysis was done to find out consumer preference by aroma, colour, flavour, and texture parameters. A feasibility study was calculated by R/C ratio (Revenue/Costs), BEP (break-even point; EUR) analysis. The result of the study shows that the Robusta coffee-cocoa formulation (RK4) was liked the most by panellists with flavour description as moderate bitter and strong cocoa aroma (RK3), meanwhile based on colour and texture aspect, the panellists prefered RK1 formulation. Whereas *R/C* ratio 1.19, *BEP* (EUR) 0.7 explain that the business deserves to be developed.

Keywords: Aceh Robusta coffee; Aceh cocoa; beverages

New product development (NPD) is needed by agroindustry to adapt to changes in the business environment (Tsimiklis and Makatsoris 2015) which are related to the massive changes in lifestyle, social status, and health (functional food), especially among youth (Benner 2005; Ribeiro et al. 2016; Jreissat et al. 2017; Samoggia et al. 2020). A striking change is the proliferation of coffee shops in big cities of the archipelago at the beginning of the second millennial decade, such as Jakarta, Bandung, Surabaya, Medan, Denpasar, Malang, and Yogyakarta. Generally, these shops sell blended Arabica coffee such as Gayo, Toraja, Java Prianger, Kintamani, Bajawa, Mandhailing, and Wamena, but not a few also sell blended beverages of Arabica-Robusta coffee (Tarigan et al. 2015) as well as coffee-cocoa. These changes are closely related to an increase in the national average income (middle income), the massive use of information technology in all activities such as college, business, or even to relax with friends/colleagues (hangout). Ali and Purwandi (2017) stated that the millennial generation is synonymous with 3C (creative, confident, and connected).

Conceptually, Maier et al. (2016) stated that NPD is closely related to the existence of technology push and the existence of market demand (market pull). According to Lubik et al. (2012), each development of a product in an industry is generally influenced by these two aspects. In the context of NPD, the Aceh Robusta coffee-cocoa mixed soft drink is influenced by the integration of these two aspects (Figure 1). In general, NPD consists of 2 main phases, namely the exploration of ideas (idea generation) and product development (idea realisation), although in some literature these two phases are described in detail from basic research to marketing (Brem

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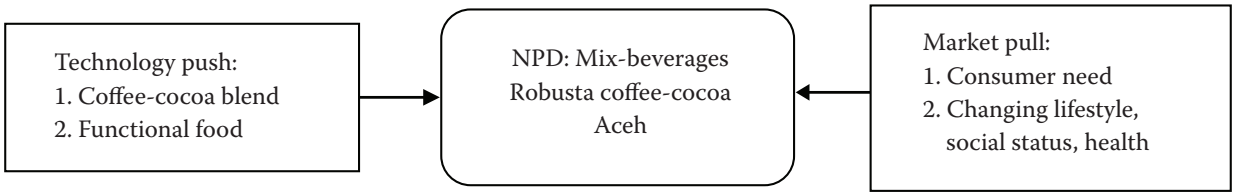

Figure 1. Description of NPD Robusta coffee-cocoa soft drinks

NPD – new product development

and Voight 2009; Akroush 2012). On the other hand, Gurbuz (2018) stated that the basis of NPD in a business is: innovation (new market), development of existing products (improvement), adding items to existing products (market-created), and product repositioning, thus also by increasing the added value of a commodity.

The fundamental for the NPD of Aceh's Robusta coffee-cocoa mixed soft drinks is an effort to increase the added value of the two commodities widely available in Aceh Province through their downstream products. This fact can be achieved with the availability and readiness of processing technology (coffee-cocoa blend). On the other hand, if it is studied based on functional food-beverages, it can be seen that in cocoa there are amino acid, antioxidant, phenolic, and polyphenol compounds (Misnawi et al. 2004) which are very good for health. In terms of taste (flavours), cocoa is unique because of the balanced combination of bitter, sour, and sweet sensations, while Robusta coffee contains much higher caffeine than Arabica coffee (Dias and Benassi 2015), so the taste sensation tends to be bitterer. The mixture of these two commodities is expected to increase consumer acceptance of the soft drinks produced.

Research on NPD mixed Aceh Robusta coffee-cocoa soft drinks is essential to be carried out when viewed from the aspect of the two commodities' production potential, the availability and readiness of technology, and the level of consumer demand. The research focuses on determining the concentration of Aceh's Robusta coffee-cocoa mixture and the potential for developing the business of this beverage product, which is assessed based on the aspect of business feasibility (economic scale).

MATERIAL AND METHODS

This research basic framework is an effort to increase the added value of Robusta coffee and Aceh cocoa. This justification explains that the Aceh Province coffee commodity is a producer of Gayo Arabica coffee and Robusta coffee. This type of coffee is generally produced from the western and central coastal areas, while dominant cacao is produced from the eastern coast (Figure 2). On the other hand, there are lifestyle changes, especial-

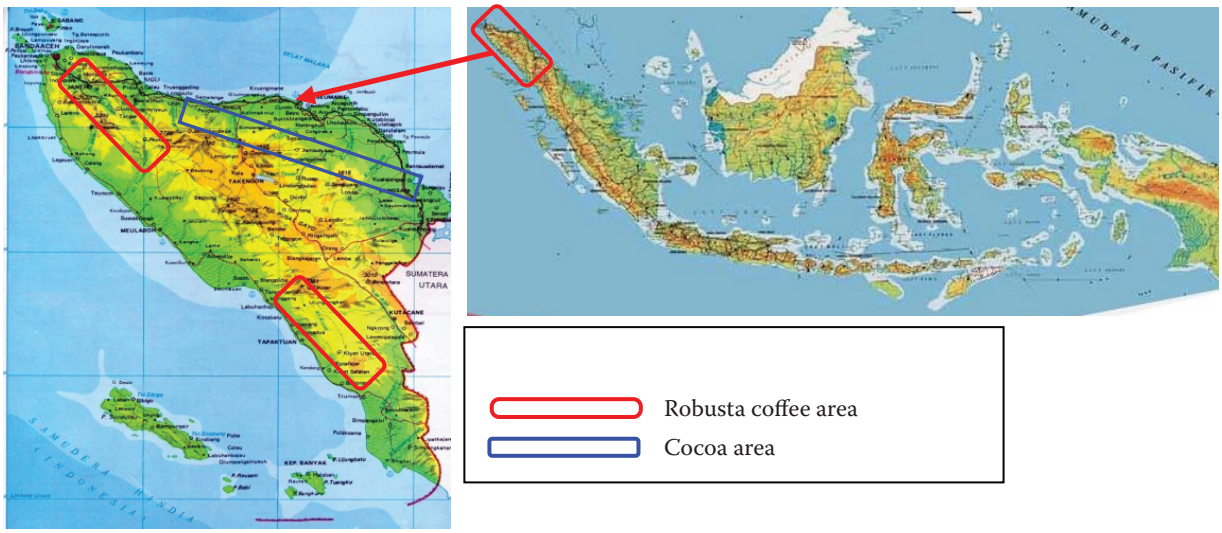

Figure 2. Robusta coffee and cocoa production centres in Aceh Province

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ly among young people who need (demand) new products from coffee and cocoa, which have tended to be brewed coffee drinks and processed cocoa in the form of food and beverages.

Overall, research was carried out in 3 phases (Table 1), adapted to the NPD stage (Kazimierska and Rębosz-Krawczyk 2017). In connection with the NPD description of Aceh Arabica-cocoa coffee mixed soft drinks, Phase I: Idea generation, which consists of gathering ideas for coffee-cocoa mixed beverage products based on the availability and readiness of technology, production potential, and a study of opportunities and demand. Phase II: Development of beverage product prototypes, calculation of business feasibility, and product commercialisation trials. Phase III: Broad product commercialisation. In this study, the activities carried out were only up to phase II.

Product design

Product design activities were carried out at the Laboratory of Agricultural Product Analysis, Syiah Kuala University, Banda Aceh, from November 2019 to January 2020. The material used in this study was Robusta coffee from Bener Meriah Regency and cocoa powder from Pidie Jaya Regency of Aceh Province. The equipment used includes roaster (Brz 2; Probat, Germany; capacity 100–300 g), roasting funnel, coffee grinder (206 N Grand; Latina, Taiwan; capacity 250 g), and roaster for cocoa (Indonesia, ICCRI; Desheller, Indonesia; capacity 25 kg).

Experimental design

This study used a completely randomised design of 4 mixed formulations of Robusta coffee and cocoa (Figure 3). Each treatment was repeated 3 times to obtain a total of 24 experimental units. Statistical analysis (ANOVA, 2-way) was carried out to see differences between treatments; if there were differences, Duncan's test was used (Steel et at. 1997).

Observational variables

In this study, the dependent variable was a soft mixed drink from Robusta coffee and cocoa with four different formulations. Simultaneously, the independent variables included sensory properties of the drink (aroma, taste, colour, and texture).

Sample preparation

Robusta coffee. The cherry red Robusta coffee is harvested from farmers' gardens according to SNI-01-2907-2008 (BSN 2008), then pulverised to separate the pulp from beans, washed, and dried until the moisture content is 40%, then diluted. The seeds are dried to a maximum moisture content of 12.5% and then roasted for 20 min at a temperature of 180 ℃ (Dharmawan et al. 2018), then sieved using an 80 mesh sieve.

Cocoa. The Forestero type cocoa harvested from farmers' gardens (selected for harvesting cocoa) refers to SNI 01-2323-2008 (BSN 2002). Cocoa pods were ripened for five days, fermented for five days, then washed and dried until the moisture content was 8% (Beckett

Table 1. Describing phases of the research

Phases	Activities	Outputs
Phase I		
Idea generation: acquisition of ideas (conceptual products and markets)	focus group discussion & personal discussion	product design and target market (who, where, how many), feedback
Literature study on technology and potential availability of raw & auxiliary materials	focus group discussion & personal discussion (continued)	availability & readiness of technology (ready to use), raw materials & auxiliary materials, feedback
Product design	production process (technical) at laboratory scale (experimental design)	product technical specifications, feedback
Phase II		
Product prototype development	business scale production process (cups & sachets)	cup & sachet products
Study of business feasibility & market potential (demand)	production units, capital, profit	the results of the analysis of *BEP*, *R/C* ratio
Commercialisation trials	production and marketing	product & profit or loss
Phase III		
Market expansion, scale-up	increase in production capacity	production capacity increased up to 100%

In this study, the activities were carried out only up to phase II; *BEP* – break-even point; *R* – revenue; *C* – costs
Source: Kazimierska and Rębosz-Krawczyk (2017)

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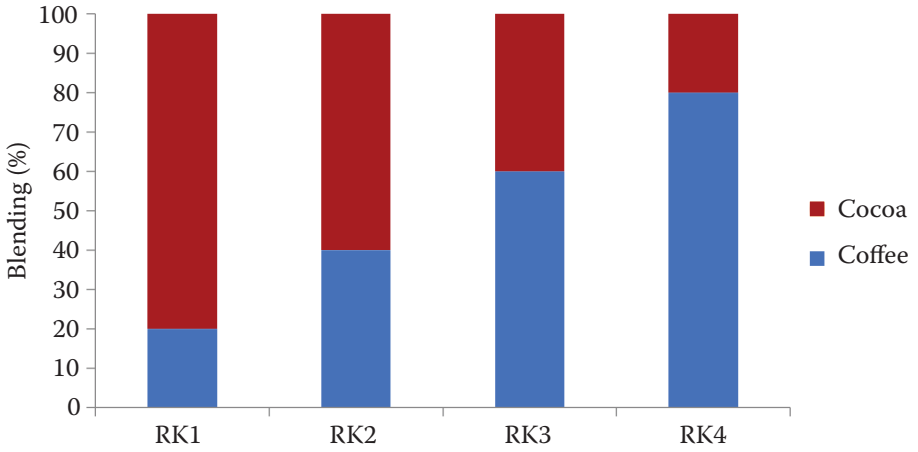

Figure 3. Formulation of Robusta coffee and cocoa blend

Blending robusta with cocoa formulation ratios: RK1 – 20 : 80; RK2 – 40 : 60; RK3 – 60 : 40; RK4 – 80 : 20

2008). For the research, cocoa powder was obtained from PT. Socolatte Pidie Jaya Regency, Aceh Province.

Robusta coffee powder and cocoa were mixed according to the respective formulations, namely 80 : 20 (consists of 80% Robusta coffee, 20% cocoa, 100 g total mixture), 40 : 60, 60 : 40, and 20 : 80. After the mixing process is complete, then brew Robusta coffee powder and cocoa with 150 mL of hot water at 90 ℃ for 5 min, then drain the Robusta coffee and cocoa mixture at 45 ℃ (Setyaningsih et al. 2010).

Hedonic test

The hedonic test as one of the sensory tests was used in this research to formulate a mixture of Robusta coffee and cocoa, including aspects of aroma, colour, taste, and texture. The hedonic test was carried out through the panellist preference test. The number of panellists involved was 20 semi-trained persons. The scale used by Likert is based on values of 1–5 (Kemp et al. 2009), while the score sheet (Table 2) used in this study includes information on panellist identity and sample coding (xxx), which is a random number. The coffee-cocoa beverage samples with different formulations were prepared using 150 mL of water at 90 °C. After stirring for 1 min and after the temperature is equal to room temperature, then the sample is presented for the hedonic test (Mulato and Suharyanto 2012).

Business feasibility analysis

The business feasibility of NPD soft drink mixed of Aceh's Robusta coffee-cocoa is important to be analysed in relation to financial feasibility (Bhuiyan 2011; Hastifarina et al. 2019) expressed in several analyses, including:

I) The ratio of revenue and production costs (*R/C* ratio) using the following formula (Equation 1):

$$R/C = \frac{TR}{TC} \quad (1)$$

where: *R* – revenue; *C* – costs; *TR* – total revenue; *TC* – total costs.

II) Break-even point analysis (Equations 2 and 3):

$$BEP\ (Q) = \frac{TFC}{P - VC} \quad (2)$$

$$BEP\ (Rp) = \frac{TFC}{1 - (VC/TR)} \quad (3)$$

where: *BEP* (*Q*) – break-even point based on the amount of production; *BEP* (*Rp*) – break-even point based on sales value; *TFC* – total fixed costs; *VC* – variable costs; *P* – selling price per unit.

Sensitivity analysis

The three analyses were used aimed at some assumptions to make projections in predicting future events. In managing uncertainty, a sensitivity analysis is needed on the primary or most influential components of the feasibility analysis projection (Saltelli and Annoni 2011).

Data analysis

The sensory test data were analysed using an Analysis of Variance (ANOVA) at the 95% significance level. If the results show a significant effect, then proceed with Duncan's Multiple Range Test (Kemp et al. 2009); the application uses a statistical package for data analysis.

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Table 2. The score sheet for the hedonic test

The score sheet for hedonic test of beverages mixed of Aceh's Robusta coffee-cacao

Name:
Phone:
Age:
Address:
Gender:
Education:
Occupation:
Code samples: xxx

Variable	Score				
	very dislike (1)	dislike (2)	fair (3)	like (4)	like very much (5)
Aroma					
Taste					
Colour					
Texture					

RESULTS AND DISCUSSION

Hedonic test. The hedonic test assessment was carried out on mixed Aceh's Robusta coffee-cocoa products (Figure 4) which covered four aspects: aroma, taste, colour, and texture. In general (Figure 5), from the colour aspect, it can be seen that the preference of the panellists for the Robusta coffee-cocoa mixture formulation is between 3.17 and 3.42 (score: fair and like) with an average of 3.312 ± 0.012. Panellists stated that the 60 : 40 (RK 3) mix was the most preferred. Statistically, ANOVA did not show a significant difference ($P > 0.05$). Based on the aspect of flavour, it ranged from 3.13 to 3.3 (score: fair and like) with an average of 3.21 ± 0.074, with the most preferred formulation of a mixture of 80 : 20 (RK 4). Statistically, there was no significant difference ($P > 0.05$) in this variable. From the colour aspect, it was shown that the panellists' preferences ranged between 3.43 and 3.57 (score: fair, like and like very much), with the average of 3.50 ± 0.058 and it was not statistically significant ($P > 0.05$). The most preferred colour chosen by panellists was the RK 1 formulation (3.57). The texture aspect ranged from 3.33 to 3.52 (score: fair and like) with an average of 3.41 ± 0.081; the RK 1 formulation was the most preferred by panellists.

In the NPD food and beverage process, one of the most important factors to consider is the performance of the product, especially from the aspect of consumer acceptance which includes quality and safety (Waller 1996); expressions of quality can be seen from the aspect of consumer preferences (acceptability) such as taste, aroma, acidity and texture (Tarigan et al. 2015; Heo et al. 2019). Overall, the NPD of Aceh's Robusta coffee-cocoa mixed drinks can be accepted by consumers, although it is very important to develop technical aspects of pro-

Figure 4. NPD of Aceh's Robusta coffee-cocoa mixed beverage

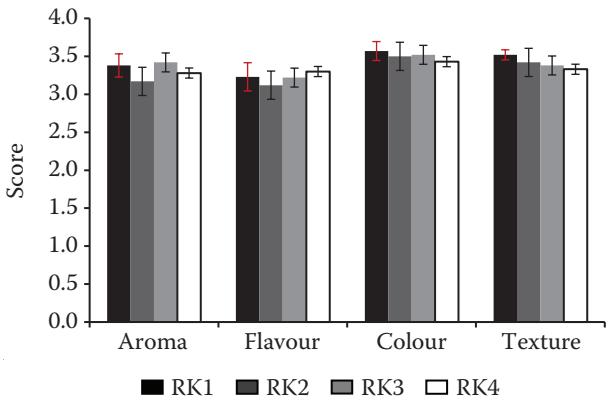

Figure 5. Mean preferences of the Aceh's Robusta coffee-cocoa beverage by panellists

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Table 3. The assumptions used

No.	Subject	Value
1.	price	constant
2.	production (cups)	3 600
3.	period (year)	1
4.	selling price/cup (EUR)	0.61

cessing to improve the quality performance of the beverage products.

Feasibility. Business feasibility analysis is needed to determine NPD performance from the business side (Bhuiyan 2011). To calculate the value of several business feasibility analyses, several assumptions were used (Table 3). In this study, the feasibility analysis is expressed in the analysis of the revenue to production cost ratio (*R/C*), break-even point (*BEP*) (Table 4), and Sensitivity Analysis (Table 5).

Based on the results of the financial feasibility analysis, it can be seen that the value of the *R/C* (EUR) is 1.71, which means that the NPD business can be carried out because it is profitable. On the other hand, in terms of *BEP*, it has only been achieved in the 2 110th cup production, meaning that it has reached 58.61% of production.

Sensitivity analysis. The sensitivity analysis (Table 4) was carried out to reduce the risk impact of an element of uncertainty in the NPD production process of the Aceh Robusta coffee-cocoa mixed soft drink. The analysis was carried out on the main components which greatly affect the feasibility of a business. In this study, the components analysed were the price of the main raw material for NPD, namely Aceh's Robusta coffee and cocoa due to the very high fluctuation in the production of the two commodities. The fluctuation is influenced by some factors such as season, pest and disease attacks, the high cost of collecting and transportation due to the scattered production locations with a limited volume, as it is generally the risk characteristic of agricultural production systems in developing countries such as Indonesia.

Table 4. Feasibility analysis performance

No.	Subject	Value
1.	*R/C* (EUR)	1.71
2.	*BEP* (cups)	2 110
3.	*BEP* (EUR)	0.43

R – revenue; *C* – costs; *BEP* – break-even point

Table 5. Sensitivity analysis for the NPD

Components	Scenario (%)	*R/C*	BEP (cups)
Robusta and cocoa price	5	1.69	2.125
	10	1.68	2.141
	15	1.66	2.156
	20	1.65	2.171

NPD – new product development; *R* – revenue; *C* – costs; *BEP* – break-even point

Based on Table 3, it can be seen that with the assumption of an increase in the price of raw materials in the form of Aceh's Robusta coffee and cocoa, it is shown that in the scenario of an increase in raw material prices up to 20%, the *R/C* value of the Aceh's Robusta coffee-cocoa mixed beverage business is still 1.65, meaning that the business is still feasible to be carried out. Likewise, with the *BEP* parameters, the break-even point of production is not very significant for business activities without an increase in the price of the main ingredients.

CONCLUSIONS

Overall, the blend formulation of Aceh's Robusta coffee and cocoa most favoured by the RK1 comparison panel is 20 : 80 (consists of 20% cocoa and 80% Robusta coffee) which has a bitter taste; moreover, adding more cocoa to the beverage will give a better taste, and is feasible to be developed.

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