# DEVELOPMENT OF CACAO POD HUSK CHIPS USING QUALITY FUNCTION DEPLOYMENT METHOD

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## ABSTRACT

*Cocoa Pod Husk (CPH) contributes 67% of fresh cocoa mass. Even though it is rich in protein, fiber, and bioactive components, the utilization of CPH has not been optimal. CPH can be used to make snacks such as chips, because chip snacks are very popular with the public. This research develops chips with the addition of CPH using Quality Function Deployment with the aim of measuring the level of consumer needs and desires for CPH chips, evaluate the quality attributes of CPH chips based on consumer wants and needs, and design its prototypes as the results of CPH chips. The utilization of CPH as a raw material for making chips is expected to be a functional snack due to its fiber content which is beneficial for health. The consumer target for CPH chips is 17-25 years old, which is a teenager who likes to consume snacks. CPH chip development is carried out using QFD starting with the production of CPH flour. After obtaining CPH flour, CPH chips are made by mixing the ingredients into the dough, flattening the dough, molding the dough, and frying it using the deep-frying method. The questionnaire distribution of CPH chips development was carried out using the Accidental Sampling method to measure the Product Performance Levels (PPL) and Consumer Need Levels (CNL) of CPH chips with the existing formula as a benchmark. The quality attributes of the CPH chips that were evaluated were the aroma, taste, texture, and color. The PPL and CNL questions on the measurement attributes questionnaire of the initial CPH chips showed valid results (r count > r table) and reliable (r Cronbach'a alpha > alpha value). Consumer evaluation of CPH chips development shows that consumers want products that have a distinctive CPH chips aroma, yellowish brown color, crunchy texture, and tasty taste. Furthermore, CPH chips are improved using CPH flour which is pretreated with soaking in 3% citric acid to produce the attributes that consumers want. Based on the results, developed CPH flour which was pretreated with 3% citric acid soaking showed a higher Whiteness Index value ($p < 0.05$) which was 43.20 ± 0.88 compared to initial CPH flour which was made without citric acid pre-soaking treatment, which was 38.90 ± 0.39. The Browning Index value of initial CPH flour was higher (6,556.20 ± 262.61) than developed CPH flour (5,383.72 ± 209.54). The product performance test showed that the developed CPH chips showed better product performance as compared to its initial CPH chips. The total dietary fiber content of developed chips was 16.10 ± 0,032% so it could be categorized as a fiber-rich product due to its dietary fiber content of more than 6%.*

Keywords: *CPH, chips CPH, dietary fiber, QFD*

## INTRODUCTION

Cocoa (*Theobroma cacao* L.) is Indonesia's mainstay commodity which has the opportunity to diversify its products with a fairly high selling price. Based on data from the Ministry of Agriculture for 2018, cocoa is the number 3 export commodity among rubber, mustard, and coffee. The Central Statistics Agency (BPS) reports that cocoa production in Indonesia is 706,500 tons in 2021. Fresh cocoa's mass consists of roughly 67% of the outer shell/cacao pod husk (CPH), which has only been used sparingly as an ingredient for compost and cattle feed which are given directly without prior treatment. Nevertheless, according to Kamelia and Fathurohman (2017), when evaluated from its potential, CPH has very good nutritional value. CPH is rich in protein, fiber, and bioactive components such as polyphenols which are useful as antioxidants (Yuliani and Gazali, 2020). CPH is a possible source of naturally occurring chemicals with exceptional nutritional and functional properties due to its high amount of dietary fiber and phenolic compounds. (Ouattara *et al*., 2021).

As the COVID-19 pandemic changes people's lifestyles, there are more functional food items available to support health and maintain the body's immunity. The consumer becomes interested in functional food ingredients that not only fulfill hunger and delectable flavors but also foods with physiological advantages for the body (Sari et al., 2022). According to the Food Safety and Standards Authority of India, sales of immune-boosting foods have increased by 20-40% (Hariyadi, 2021). The physiological function of food is to increase the body's immunity, prevent disease, and maintain the physical condition of the body (Khoerunisa, 2020). Fruits and vegetables, whole grains, foods and beverages that have been fortified, as well as some dietary supplements, are some examples of these foods. Several traditional foods' functional qualities are being uncovered and examined, and new food

products are being created with advantageous ingredients. According to Fertiasari & Hidayat (2021), fried dumpling skin is a potential product that must be developed because it is a snack that is quite popular with consumers.

Irdianty's (2016) stated that most subjects have a snack consumption frequency of more than 4 times a week, both in rural and urban adolescents. Today's young consumers are thought to be more interested in modern snacks that contain various benefits that are good for health and satisfy hunger in a short time. Snacks are foods consumed between the three main meals each day (Forbes *et al*. 2015). The primary ingredient in dumpling skin is wheat flour (Lan *et al*., 2010). The substitution of CPH flour in fried dumpling skin is still limited, even though it has the potential as a functional ingredient to increase the fiber content. Adding CPH flour as the functional ingredient of CPH chips provides food diversity and increases the economic value of CPH. QFD is a structured product development planning method that assists producers in translating consumer needs and desires and systematically evaluating product capabilities to meet these consumer needs and expectations (Ariani, 2007). The purpose of developing chips with the addition of CPH using Quality Function Deployment is to measure the level of consumer needs and desires for CPH chips, evaluate the quality attributes of CPH chips based on consumer wants and needs, and design its prototypes as the results of CPH chips.

## METHOD

### Consumer Identification

Consumer identification was carried out by preparing the materials used to make the initial CPH chips and then distributing the initial questionnaires to find out the desires and needs of consumers for the development of CPH chips. The distribution of CPH chips product development questionnaires was carried out using the accidental sampling method. According to Sugiyono (2011) and Sugiono (2013), accidental sampling is a sampling technique based on chance, that is, every respondent who happens to meet a researcher can be used as a sample if it is deemed that the person met by chance is suitable as a data source. Malhotra (2006) states that the number of respondents must be at least four or five times the number of question items. So based on the CPH chips product development questionnaire, a minimum of 95 respondents was taken because (19 questions x 5 is 95) so they were rounded up to 100 respondents, and in this study the researchers used 104 respondents. The questionnaires used in this step include consumer demographic, the Product Performance Levels (PPL) and Consumer Need Levels (CNL) of CPH chips with the existing formula as a benchmark. The quality attributes of the CPH chips that were evaluated were the aroma, taste, texture, and color.

### Product Development

The development of CPH chips was carried out concerning the consumer's desire based on the analysis of the results of the distribution of CPH chips development questionnaires. The development of CPH chips is carried out by applying the process improvement that has been prepared in the House of Quality (HoQ). Making CPH chips is done by adjusting the steps and recipe for making fried dumplings according to Imar (2017) method. CPH flour is mixed with wheat flour in a ratio of 5.78:1 or 21.62 g of CPH flour and 125 g of wheat flour. The seasoning used in making CPH chips consists of 10 g of garlic, 0.5 g of pepper, 1 g of salt, and 5 g of powdered stock. To make the dough easier to smooth quickly, the dough is ground using a noodle grinder. After the dough is smooth, the dough is flattened using a noodle grinder with a thickness of 1 mm to obtain a crunchy chip texture. The dough is cut into squares using a knife with a size of 3x3 cm. Chips were cut using a knife to obtain a uniform size with a size of 3 x 3 cm following the size of the CPH chips that had been carried out in Anoraga's (2022) study. CPH chips are square in shape with bite size so they can fit in the mouth once. CPH chips are fried using a deep-frying method. The chip is immersed in vegetable oil, at a high temperature, and for a short time. According to Mujadin et al. (2014), the ratio of oil to ingredients fried using deep frying is 8:1 and frying can be done five times in a row without changing, adding, or reducing the amount of oil used in frying. Deep frying is done to produce a product that has a crunchy texture, attractive color, savory taste, and distinctive aroma. The preparation of the House of Quality (HoQ) is carried out using Microsoft Excel starting from the identification stage of the quality attributes of the CPH chips. Furthermore, determining the target to be achieved and how the solution is to achieve the target desired by consumers are done before identifying between solutions that mutually influence other quality attributes. Competition analysis was carried out which was the average value of the PPL and CNL of CPH chip products based on the respondents' ratings. Determining the future goals of the development of CPH chips, calculating improvement ratios, determining selling points, calculating the scale of consumer needs, and normalizing the scale of consumer needs.

The Product Performance Level (PPL) value presented at the PPL is the average respondent's assessment of each quality attribute of CPH chips products. The Consumer Need Level (CNL) is the average rating for each CNL quality attribute of CPH chips products. Determination of future goals is carried out by researchers to be able to satisfy consumers with the best judgment. Determination of the improvement ratio is done by comparing the desired level of performance with the level of product performance (Eq. 1). The selling point is a value that shows the effect of changes in quality attributes on the level of sales that occur and is determined by the researcher. Determination of the Consumer Needs Scale (CNS) was carried out to describe the performance of consumer satisfaction with CPH chips products. CNS value is the implementation of product performance improvement and sales potential (Eq. 2). While the calculation of Consumer Needs Scale Normalization (CNSN) is a percentage of the CNS value.

Improvement ratio $= \frac{future\ goals}{Product\ Performance\ Level}$ (1)

Consumer Needs Scale (CNS) = CNL x repair ratio x selling point (2)

Consumer Needs Scale Normalization (CNSN) $= \frac{CNS}{total\ CNS}\ x\ 100\%$ (3) (Hadi, 2017)

### Evaluation

The evaluation stage in this study was carried out to compare the performance of the initial CPH chips and the developed CPH chips which included: product performance test, color test, texture test, and total food fiber test. The product performance test of CPH chips products was carried out by distributing questionnaires and CPH chips products to 30 panelists who were respondents

in identifying consumer needs for the development of CPH chips products that had been carried out previously. Panelists in the development of CPH chips products use semi-trained panelists, namely panelists who have been explained to identify the quality attributes of CPH chips. The product performance test was carried out to compare the sensory attributes of the initial CPH chips and the developed CPH chips. Sensory attributes are a group of words to describe the sensory characteristics of food products, including color, appearance, shape, taste, and texture. A good appearance of a product will affect product images, such as taste and quality (Nurhayati, et al., 2012). The color test was carried out on samples of initial CPH flour and developing CPH flour. Color testing is carried out using the Colorimeter tool used, namely the AMT501 using L, a, b notation (Mendoza, et al. 2007). Texture test is performed to determine the mechanical characteristics of a sample. Texture testing was carried out using the Imada Texture Analyzer from IMADA's Force Measurement. The texture test was carried out by testing the hardness of the CPH chips. Hardness is the maximum peak at the first pressure expressed in units of N.

## RESULT AND DISCUSSION

### Identification of Consumer Wants and Needs

Identification of consumers' wants and needs for the development of CPH chips was carried out by distributing questionnaires to respondents by providing samples of CPH chips which were processed using initial CPH flour which was processed without citric acid soaking treatment. The visual appearance of the initial CPH chips is shown in Figure 1. The initial CPH chips were used as a benchmark for the development of CPH chips according to the needs and desires of consumers. The quality attributes of the CPH chips are quality attributes that can be assessed by consumers directly by tasting the CPH chips. The attributes of the quality of CPH chips that was analyzed in this study were aroma, color, texture, and taste which could influence consumer acceptance. The demographics of the respondents used in the development are presented in the following Table 1.

Figure 1 Initial CPH Chips

Table 1. Respondents' Demographics for Development of Initial CPH Chips

| **Respondent Demographics** | | |
|---|---|---|
| **Category** | **Information** | **Percentage (%)** |
| Age | 17-25 years old | 95.19 |
| Last education | Bachelor | 14.42 |
| | Diploma | 31.73 |
| | Senior High School | 49.04 |
| Profession | Government Employees | 2.88 |
| | Self-employed | 5.77 |
| | Private sector employee | 10.57 |
| | Student | 75.96 |
| Monthly income | > Rp 4.500.000 | 2.88 |
| | Rp 3.000.000,1 - Rp 4.500.000,00 | 5.77 |
| | Rp 1.500.000,1 - Rp 3.000.000,00 | 20.19 |
| | < Rp 500.000,00 | 21.15 |
| | Rp 500.000,1 - Rp 1.500.000,0 | 45.19 |
| Domicile | Central Java | 34.62 |
| | DIY | 60.57 |

The target age of respondents is 17-25 years in D.I.Y and Central Java with a lifestyle that tends to choose to consume highly nutritious snacks. The choice of food types and the frequency of consumption of snacks affect nutritional adequacy and are able to suppress hunger between main meals (Dwijayanti, 2021). Most of the respondents were students with an average monthly income of IDR 500,000.1- IDR 1,500,000.00 (45.19%). Amaliyah *et al*. (2021) stated that adolescence is a period that is vulnerable to nutritional needs. Many teenagers do not meet their nutritional needs because they are afraid of being overweight. Based on this, the development of CPH chips which is a high-fiber snack is primarily aimed at teenagers. Product improvements that consumers want are the brighter CPH chip's color, original aroma, savory salty taste, crunchy texture, and square shape. The packaging size that consumers want is a couple pack (100 g). CPH chips is packaged using standing pouch packaging made of aluminum foil. The price for CPH chips is between IDR 10,000 - IDR 15,000. While purchasing CPH chips, customers take into account the pricing, packaging, and shape of the product as well as the fact that CPH chips are a tasty, wholesome snack. In response to the Covid-19 outbreak, consumers are choosing healthier snacks because they care more about their bodies' health, immunity, and nutrition than ever before. A consumer's subjective assessment of pricey or inexpensive products depending on the level of quality offered is the pricing factor. When purchasing chips, people take the product packaging into account. Consumers' first impression of a product is its packaging. If the packaging is appealing, the consumer will also think the product is tasty. According to Aini *et al*. (2014), packaging plays a role in consumer decision-making since it acts as a stimulus for consumers to acquire CPH chips.

The House of Quality (HoQ) in this study was structured for the development of CPH chips according to the needs and desires of consumers based on the analysis of the results of the distribution of the questionnaires. The preparation of the HoQ for the development of CPH chips is carried out to improve the product quality attributes of aroma, color, texture, taste, and shape of CPH chips which are a list of consumer needs. The future goal of developing CPH chips is worth 4, meaning that the quality attributes of CPH chips have the best value. The higher the repair ratio value, the product quality attribute becomes a priority for improvement. Based on the results of the calculation of the highest improvement ratio value, namely the color quality attribute of CPH chips (1.26). The color of the CPH chips produced in the initial manufacture of chips had a fairly dark color, so it was necessary to modify the production process while maintaining the fiber content of the CPH chips. Improvements were made by improving the color of CPH flour with citric acid soaking treatment to obtain a brighter color of CPH flour. The overall selling point of the quality attributes of CPH chips is 1.5 which indicates changes in product attributes will have a major influence on the level of customer satisfaction and the level of product sales.

**Development of CPH chips**

The chip development product with the addition of cocoa shell flour is processed with a predetermined composition, based on the recipe in the research of Bhirawa et al. (2022) and the website www.cookped.com for processing wonton chips. In order to produce a brighter CPH chips color while still maintaining the dietary fiber content, a modification of CPH flour production was carried out by pretreating the CPH in citric acid soaking as an inhibitor for the browning reaction. According to Hidayat *et al.* (2012), the prevention of enzymatic browning reactions that are widely used in the processing of dry green pepper is a combination of soaking in hot water (blanching) and the addition of sulfites.

Purwanto and Ririn (2016) stated that the existence of pre-treatment such as the addition of ascorbic acid as an effort to prevent browning reactions can increase the level of brightness. The application of citric acid soaking and blanching methods in the manufacture of CPH flour resulted in significantly different WI and BI ($p<0.05$). The results of the initial CPH flour color test which was processed without the addition of citric acid and the developed CPH flour with the addition of citric acid are shown in Table 2. The initial CPH flour produced without the addition of citric acid had a significantly lower Whiteness Index value ($p<0.05$) than the Whiteness Index value of the developed CPH flour produced with the addition of citric acid. Purwanto & Ririn (2016) stated that the existence of pre-treatment such as the addition of ascorbic acid as an effort to prevent browning reactions can increase the level of brightness. The degree of browning (BI) of initial CPH flour had a significantly higher value ($p<0.05$) than developing CPH flour.

Table 2. Initial and developed CPH flour color test results.

| **Sample** | **Picture** | **Color Code** | **BI (*Browning Index*)** | **WI (*Whiteness Index*)** |
|---|---|---|---|---|
| Initial CPH flour |  | Code: 926C3F | 6,558 ± 263[a] | 39 ± 0.39[a] |
| CPH flour development |  | Code: 98764A | 5,383 ± 210[b] | 43 ± 0.88[b] |

Data represent mean ± standard deviation. The mean values in columns with different subsets showed significant differences at $p<0.05$.

CPH chips texture was analyzed using a texture analyzer which showed that the initial CPH chips hardness was 6.50 ± 1.26 N higher ($p<0.05$) than that of the developed CPH chips of 3.90 ± 1.23 N (Table 3). The hardness of CPH chips indicates the minimum amount of force required to fracture the CPH chips. The hardness of CPH chips is affected by the thickness of the dough in the process of flattening before frying. The thinner the printed dough and the addition of margarine to the dough, the crisper the chips produced will be. The total dietary fiber of the initial CPH chips was 6.59 ± 0.05% which is lower (p.0.05) than that of the

total dietary fiber of the developed CPH chips, which was 16.10 ± 0.032% (Table 3). The high content of dietary fiber in developed CPH chips could be caused by the addition of corn flour in the dough. Augustyn, *et al*., (2019) tated that corn flour contains high fiber which ranges from 8.56-9.36%. Based on the Regulations of the Drug and Food Control Agency, the limit required for the food fiber content of a food that is declared rich in fiber in solid form is not less than 6%. The fiber content of developed CPH chips is able to compete with high fiber chips (Fitchips) on the market, where the amount of fiber in Fitchips's is 2% in a 15 g serving.

Table 3. Hardness and Dietary Fiber of l CPH Chips Products

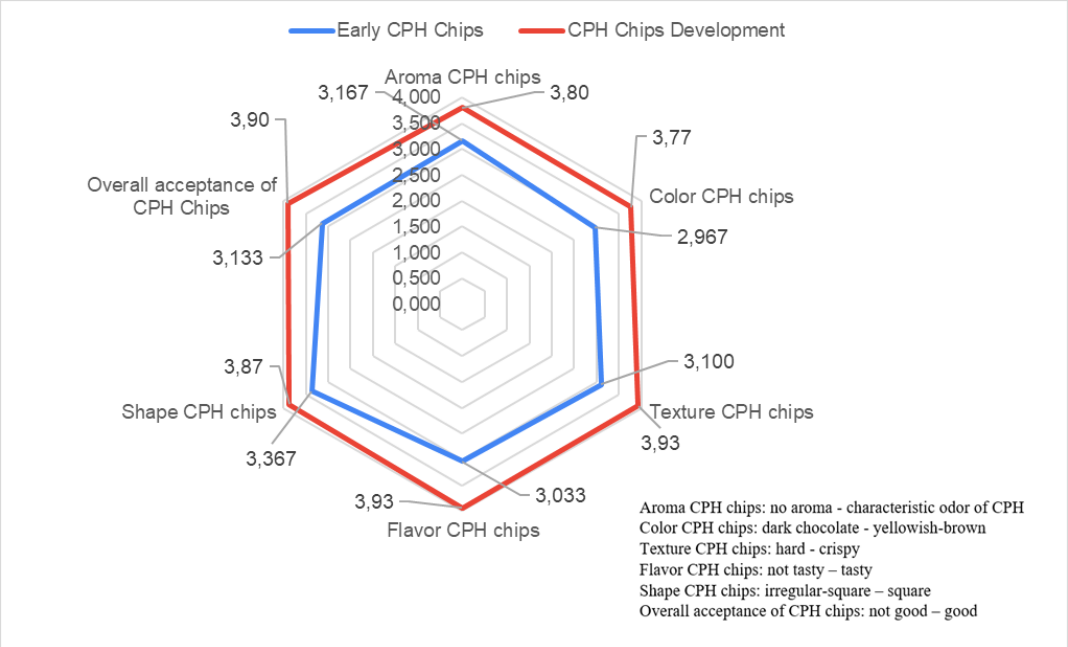
| **Attributes** | **Initial CPH Chips** | **Developed CPH Chips** |
|---|---|---|
| Hardness Test (N) | 6.46 ± 1.26[a] | 3.96 ± 1.23[a] |
| Total Dietary Fiber Test (%) | 6.59 ± 0.05[a] | 16.10 ± 0.032[b] |

Data represent mean ± standard deviation. The mean values in columns with different subsets showed significant differences at $p<0.05$.

**Developed CPH Chips Evaluation**

Evaluation of CPH chips was conducted to compare the initial CPH and developed CPH chips. According to Setyaningsih *et al*. (2014), the purpose of the sensory analysis is to determine the response or impression of the five human senses to stimuli arising from a food product. The texture and consistency of food ingredients will affect the taste produced by food products. Changes in the composition and texture of a food ingredient can change the smell and taste which affect the stimulation of receptor cells from the salivary glands (Winarno, 2004). Product performance testing is carried out to determine consumer acceptance of CPH chips, whether they are acceptable and in accordance with consumer desires. The overall acceptance of the quality attributes of CPH chips has shown that respondents like the developed CPH chips (Fig. 2). The suggestions given by consumers for the development of CPH chips mostly asked to provide a saltier taste, but everyone's level of acceptance of salty taste was different. Respondents also wanted the size of the wonton crackers to be bigger and thinner, so the taste was savory and crunchier. The overall assessment of CPH chips has been acceptable to consumers.

Figure 2 Product Performance Testing of CPH Chips




Ketaren (2014) stated that consumer acceptance from several regions, generally in Indonesia, which is an archipelagic country with various cultures related to food consumption habits, has differences. The first impression given by consumers of CPH chips color is that of a sweet product. This is because the color of CPH chips is dark brown, so consumers assume that CPH chips have a sweet taste. Johnson (2021) states that errors in this sensory test are stimulus errors, namely errors caused by irrelevant criteria.

**Calculation of the Cost of Production of CPH Chips**

The cost of production is calculated based on production costs which consist of raw material costs, and overhead costs. The price of developed CPH chips can also compete with the price of Fitchips which are on the market at an average of IDR 11,000 per 55 g. The cost of production is calculated based on production costs which consist of raw material costs, and overhead costs. Table 4 shows the calculation of the HPP CPH chips using the full costing approach.

Table 4 Calculation of COGS and added value of CPH chips using the Full Costing Approach

| **Calculation of HPP CPH Chips** | | | | | |
|---|---|---|---|---|---|
| **Information** | | **Volume** | **Unit** | **Price/unit (Rp)** | **Total (Rp)** |
| Raw Material Costs | CPH flour | 175 | g | 70 | 12,250 |
| | Wheat flour | 1000 | g | 15 | 15,000 |
| | Garlic | 80 | g | 28 | 2,240 |
| | Pepper | 4 | g | 1,000 | 4,000 |
| | Mushroom broth | 56 | g | 275 | 15,400 |
| | Salt | 16 | g | 160 | 2,560 |
| | Oil | 3 | l | 15,000 | 45,000 |
| | Total | | | | 96,450 |
| Overhead Cost | Labor costs | 1 | Person | 20.000 | 20,000 |
| | Deepfryer | 2 | KWh | 1,699 | 3,399 |
| | Lighting | 0,24 | kWh | 1,699 | 408 |
| | Sub-Total | | | | 23,807 |
| Total | | | | | 120,257 |
| HPP CPH Chips per gram | | | | | 69 |
| Value Added Product | | | | | 0,61% |

Development of CPH into food products provides significant added value. Apart from functioning as a functional food, CPH can provide added economic value from having no value to selling value by processing it into functional food. Calculation of added value in the development of CPH into CPH flour is able to provide added value with a ratio of 0.61%. This is because CPH originating from plantations does not have a selling value and has not been optimally utilized and then used as a functional food ingredient with a selling value. Functional food occupies a position between conventional food and medicine, besides that functional food can also be used to prevent disease at an early level, not as a cure for advanced disease. Functional food is designed using food ingredients or bioactive components as the basis for processing (Astuti, 2017). The added value of utilizing cocoa shells in the manufacture of chips when defined in nominal terms looks very small because the gram of cocoa shell flour used in the manufacture of CPH chips is quite small with a ratio (5.78:1). However, the use of cocoa shell flour is able to turn waste into food products that are very beneficial for maintaining health.

**Packaging Design**

CPH chips packaging was designed using aluminum foil packaging with a size of 100 g and was designed based on a questionnaire analysis. This 100 g package is said to be a couple package because it has a portion that is not suitable for consumption by two people. Flexy Pack (2022) states that aluminum foil packaging is suitable packaging for packing chips, crackers, biscuits, and other snacks that are prone to sluggishness. The characteristics of aluminum foil packaging as a packaging material are having low permeability to air, not reacting with the product, not easily oxidizing or leaking, and being heat resistant. The small permeability of aluminum foil is able to prevent microbial contamination that can damage food, thereby extending the product's shelf life. The standing pouch was chosen as packaging for developed CPH chips because it is able to display the impression of a premium product equipped with a zipper that makes it easy for consumers to open and close the package easily and practically. The CPH chips packaging logo design is made with a combination of white and brown colors as a visualization of the raw material for making developed CPH chips. The white color indicates the color of wheat flour, and the brown color indicates the color of CPH flour which is the raw material for making CPH chips (Fig. 3).


Figure 2 Front and rear view of the CPH chips packaging design

## CONCLUSION

Cocoa Pod Husk (CPH) could be utilized to develop high dietary fiber cips using Quality Function Deployment. The quality attributes of the CPH chips that were evaluated were the aroma, taste, texture, and color. Consumer evaluation of CPH chips development shows that consumers want products that have a distinctive CPH chips aroma, yellowish brown color, crunchy texture, and tasty taste. Furthermore, developed CPH flour which was pretreated with 3% citric acid soaking showed a higher Whiteness Index value ($p < 0.05$) which was 43.20 ± 0.88 compared to initial CPH flour which was made without citric acid pre-soaking treatment, which was 38.90 ± 0.39. The Browning Index value of initial CPH flour was higher (6,556.20 ± 262.61) than developed CPH flour (5,383.72 ± 209.54). The results of testing the performance of CPH chips products by consumers showed that the developed CPH chips showed better product performance as compared to its initial CPH chips. The total dietary fiber content of developed chips was 16.10 ± 0,032 % so that it could be categorized as a fiber-rich product due to its dietary fiber content of more than 6%.

## REFERENCES

Aini, S.N., Syafi'I, I., & Kuntadi, E. B. (2014). Perilaku Konsumen dalam Pembelian Keripik SingkongRasa Asin di Kabupaten Bondowoso. *Berkala Ilmiah Pertanian,* 1(1), 1-8.

Amaliyah, M., Soeyono, R. D., Nurlaela L., Kristiastuti, D. (2021). Pola Konsumsi Makanan Remaja di Masa Pandemi Covid-19. *Jurnal Tata Boga*, 10(1), 129-137.

Anoraga, S. B., Bayu, C. B., PrameliniL., G., Hida, F. N., Sari, A. R., & Rahmatika, A. M. (2022). Optimasi Formulasi Kerupuk Pangsit Kaya Serat dan Antioksidan dengan Menggunakan Tepung Kulit Kakao. *Agrointek*, 17(2), 274-280.

Ariani, D.W. (2007). *Manajemen Kualitas*. Jakarta: Penerbit Erlangga.

Astuti, M. (2017). Makanan Fungsional, Konsep, dan Peraturannya. Agritech. 17(4): 29-32.

Bhirawa, S. A., Cristyn S. B., Luari G.P., Fatma N.H., Anjar R.S., & Annie M.R. (2022). Optimasi
Formulasi Kerupuk Pangsit Kaya Serat dan Antioksidan dengan Menggunakan Tepung Kulit
Kakao. Agrointek, 17(2): 274-280.

Fitri, E., Effendi, & Azra, A. (2021). Utilization of Dry Cocoa Pod Husks as an Antioxidant-Rich Herbal Drink. *Eksakta,* 22(02), 102-109.

Flexy Pack. (2022). *Standing Pouch* Alumunium Foil [https://flexypack.com/news/standing-pouch aluminium-foil]

Forbes, S. L., Kahiya, E., Balderstone, C. (2016). Analysis of Snack Food Purchasing and Consumption Behavior. *J Food Prod Mark,* 22(1), 65-88.

Hadi, I. S. (2017). *Penerapan Quality Function Deployment Dalam Upaya Peningkatan Kualitas Produk Kain Batik Tulis Pada Sanggar Batik Seblang Banyuwangi*. Jember : Digital Repository Universitas Jember.

Johnson, M. (2021). Psychological Errors. *Society of Sensory Professionals.*

Kamelia, M., & Fathurohman. (2017). Pemanfaatan Kulit Buah Kakao Fermentasi sebagai Alternatif Bahan Pakan Nabati serta Pengaruhnya terhadap Pertumbuhan Ternak Entok (*Cairinamuschata*). *Jurnal Tadris Pendidikan Biologi,* 8(1), 66-77.

Khoerunisa, T. K. (2020). Review: Pengembangan Produk Pangan Fungsional di Indonesia Berbasis Bahan Pangan Lokal Unggulan. *Indonesian Journal of Agriculture and Food Research.* 2(1), 49-59.

Mendoza Fernando, Petr Dejmek, Jose M. Aguilera. (2007). Colour And Texture Analysis In
Classification Of Commercial Potato Chips. Food Research International 40 (2007) 1146 –
1154. Lund University . Sweden.

Nurhayati, A., Lasmanawati, E., & Yuia, C. (2012). Pengaruh Mata Kuliah Berbasis Gizi pada Pemilihan Makanan Jajanan Mahasiswa Program Studi Pendidikan Tata Boga. Jurnal
Penelitian Pendidikan, 13(1), 1-6.

Purwanto, Y. A., & Ririn N. E. (2016). Penggunaan Asam Askorbat dan Lidah Buaya untuk Menghambat Pencoklatan pada Buah Potong Apel Malang. *Jurnal Keteknikan Pertanian,* 4(2), 203-210.

Setyaningsih D, Apriyantono A & Sari M.P. (2010). *Analisis Sensori untuk Industri Pangan dan Agro.* Bogor: IPB Press.

Winarno, F. G. (2004). *Kimia Pangan dan Gizi.* Jakarta: Gramedia.

Yuliani, F., dan Gazali, F. (2020). Pemanfaatan Kulit Buah Kakao sebagai Sumber Antioksidan Alami. *Journal of Multidicsiplinary Research and Development,* 2(4).