Packaging development of dehydrated strawberry using quality function deployment for e-commerce

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Abstract. Dehydrated strawberry is product development from strawberry fresh fruit to improve, increase the shelf-life and value of the product. During the Covid-19 pandemic, shopping lifestyle has changed gradually into online buying through e-commerce that was growth significantly, it must be followed by producer to adapt and adopt the situation especially for purchasing decisions, while customers tend to choose products based on the packaging appearance. This study aimed to determine attributes of the packaging and technical needs for producer selling preparation of dehydrated strawberry in e-commerce based on customer needs. The method in this study that has proven effective in fulfilling customer needs is Quality Function Deployment (QFD) in product planning phase. QFD analysis begins with filtering Voice of Customer (VoC) using open questionnaire then at the stage of customer importance level and product performance using closed questionnaire, then compiled into attributes of customer needs. Technical requirements were brainstormed using discussion with local sellers on e-commerce. Two attributes with the highest priority to be realized is product information on the packaging is easy to read and understand and product-related information fully listed on the outer product packaging and the highest priority for the technical needs is addition of secondary packaging.

1. Introduction
Strawberry production in Indonesia encountered with many post-harvest problems such as distribution chain length that makes the strawberries are damaged during the transportation process and the lack of processing to turn fresh strawberry fruit into a new product with higher economic value [1]. In postharvest handling of fruits, the application of osmotic dehydration (OD) is currently widely applied to extend the shelf life by which new products with higher economic value can be produced. Processing of fruits using the OD technique is then continued with other preservation techniques such as hot air-drying using tray dryer [2]. From the processing of strawberries with this technique, a new product is produced in the form of dehydrated strawberry which can be stored for up to 6 months at room temperature of 26°C [3]. Dehydrated strawberry can be consumed in various ways, either mixed into other foods such as cereals, granola, salads, or cakes, dairy products, sweets or made into snacks that are rich in antioxidants [4].

The COVID-19 pandemic that is currently sweeping the world has caused significant changes in human lifestyles. Along with the policy implementation to stay at home as a step to prevent the spread of the virus, as many as 31% of respondents experienced an increase in online shopping activities [5]. In product marketing through e-commerce, producer must be able to adapt and adopt this situation...
especially for purchasing decisions, customers tend to choose the products based on the packaging appearance [6].

In terms of packaging handling, current product packaging that has the best type of packaging that can maintain the product quality is 75micron thick nylon monolayer plastic with vacuum handling. The packaging is able to maintaining the quality of dehydrated strawberry in terms of quality parameters including physical, chemical, and microbiological [7]. Of course, the packaging needs to be developed for suitable to be marketed through e-commerce, that the packaging should not be only meets the requirements of the packaging function which can protect the product (functional), but also meets the actual customer needs of product packaging, especially in terms of visuals, so that customers are more interested in buying the products through e-commerce.

The right method that has proven to be effective to solve these problems is to use the Quality Function Deployment (QFD) method that uses the basis of customer needs, finds innovative responses to these customer needs, then improves the quality of the products developed in order to meet customer expectations, which are in accordance with the needs of the research. This study uses the QFD method at the product planning process stage using HoQ matrix. The complete structure of HoQ can be seen in Figure 1.

2. Method
Development of dehydrated strawberry packaging for e-commerce in this study uses Quality Function Deployment (QFD) method because in accordance with the purpose of the study, the method uses the basis of customer needs, find innovative responses to these customer needs, then improves the quality of the product in order to meet customer requirement. Specifically, this study uses product planning stage of QFD, using HoQ matrix. The complete structure of HoQ can be seen in Figure 1.

2.1. Types and sources of data
The data used in this study consisted of two data types, primary and secondary data. Primary data obtained directly from respondents i.e. people who have sold or bought or consumed packaged dehydrated strawberry product. The primary data needed in this study include respondent information,
customer importance and satisfaction level, as well as customer needs and specifications of the dehydrated strawberry packaging in e-commerce obtained through the results of observations and surveys using a questionnaire. While the secondary data needed in this study are data that related to the research object, validity and reliability testing, product quality standards, packaging attributes, packaging, and product development methods obtained through electronic sources.

2.2. Data collection technique
The data of this study were obtained through field and literature studies. For field studies, data were collected through observation, discussion, and survey using questionnaire filled by respondents. At the stage of identifying customer needs, an open questionnaire was distributed to 10 respondents to filter VoC so that respondents could provide in-depth answers according to their experience and knowledge. Meanwhile, in the validity and reliability test, a closed questionnaire was used and an initial distribution of the main questionnaire was carried out to 30 respondents. Then in the advanced stage, analysis of the customer importance level and product performance was carried out using the main questionnaire through further distribution to 100 respondents. While literature studies were obtained to collect secondary data, such as journal, book, or electronic source.

2.3. Data analysis
Data analysis in this study uses HoQ matrix which can be seen in Figure 1. There are six main steps in data analysis using QFD product planning stage that are:

1) Identification of customer needs. Identification is done by observing and distributing an open questionnaire in order to obtain WHATs from the matrix. The use of an open questionnaire aims to obtain true unlimited information from respondents about the object and obtain the actual VoC. At this stage, after obtaining VoC which is then compiled into ACN, data analysis is carried out by validity and reliability test of the attributes that have been obtained before proceeding to the next stage. The importance of each attribute is measured based on the results of the ACN importance level questionnaire after the test shows the results of the questionnaire are valid and reliable.

2) Planning matrix. Each ACN that has been obtained is then measured the level of product performance through benchmarking stages between the product packaging developed and competing import product packaging (Doi Kham Brand, Thailand). Then, the calculation of improvement ratio and determination of future goals also sales point is carried out through discussion with the seller. To determine the priority level of each ACN, the scale of customer importance and its normalization (%) is calculated for each ACN. The greater the value generated, the higher the priority of the ACN to be realized.

3) Framing technical needs. The ACN that has been obtained is then translated into technical needs (HOWs) to make it easier for sellers to realize ACN in developing product packaging so it can meet customer needs. Identification of technical needs is carried out by researchers taking into account the results of literature studies and discussions with sellers related to repair direction of each technical needs.

4) Relationship matrix. Determination of the relationship between ACN and technical needs is carried out using the relationship matrix symbol (none, weak, moderate, strong). Every WHATs must be answered by HOWs, as of to increasing satisfaction with ACN, the parameters in technical needs must be increased. Which one is more likely to be improved can be seen based on the relationship.

5) Technical needs correlation matrix. Analysis of the relationship between technical needs is carried out to determine the relationship between each of the technical needs that can be either positive or negative. Technical requirements with a positive relationship indicate that these technical needs support each other, while a negative relationship indicates that these technical needs inhibit each other in the product development process.

6) Technical needs matrix. In this matrix, determination of the level of difficulty of technical needs is carried out by discussing with the seller and calculating the priority and its normalization (%) to
determine the priority level of each technical need. The greater the value generated, the higher the priority of the technical needs to be realized.

3. Result and Discussion

3.1. Dehydrated strawberry and online product packaging
Dehydrated strawberry is one of the products from the preservation of fresh strawberries in order to obtain a new product that is more durable. The product is obtained from the results of pre-treatment using an osmotic dehydration technique, then followed by convective thermal drying using a tray dryer [7].

The standard of dried fruit packaging is the product packaged in a tightly closed container, not affected or affected by the contents, safe during storage and transportation [9]. That packaging standard has not been detailed related to such as materials, material properties, material characteristics, labels, packaging forms, and others. Specifically, dried fruit requires packaging with materials that have a good barrier to moisture, $O_2$, $SO_2$, and other volatiles. This is because the surface of dried fruit is very sensitive to moisture and oxidation [10]. Meanwhile in general, related to packaging labels, processed food packaging labels must contain information on at least 8 main aspects [11].

For online marketing, the product packaging needs to be given additional packaging so that the product remains safe and shocks that occur to the product can be minimized during the distribution process [12]. Packaging of products that marketed through e-commerce must be able to protect the product in terms of literal function, but packaging has marketing potential that is quite influential on product sales. Compared to offline sellers, online sellers have less contact power in providing satisfaction to consumers, as of online sellers must be able to provide a memorable experience for consumers and outperform competitors in making online product purchase decisions, especially through packaging [13].

3.2. Data collection records
In this study, two types of questionnaires were used at several stages in the QFD analysis. At the stage of identifying consumer needs, an open questionnaire was distributed to 10 respondents and homogeneous answers were obtained regarding customer needs for dehydrated strawberry packaging for e-commerce, which then became input for the WHATs section.

Then at the initial stage of distributing the main questionnaire, a closed questionnaire was used which was filled out by 30 respondents to then be tested for validity and reliability. Of the 10 attributes, all of them were declared valid and reliable, so that they could proceed to the next stage, the continued distribution of the main questionnaire to 100 respondents. In the follow-up distribution, a questionnaire was also distributed which functions to analyze customer importance level and product performance which was also filled out by the 100 respondents. The results of the analysis become input to the planning matrix.

3.3. Customer needs (WHATs)
Customer needs were identified based on the results of literature studies and survey observations using an open questionnaire to filter VoC as WHATs. Product packaging attributes are divided into two main attributes, namely verbal and visual attributes. Verbal attributes related to product information and to address the cognitive side of decision making. While visual attributes can be divided into several sub-attributes includes: (a) graphics, (b) color, (c) shape, (d) size, and (e) packaging materials [14].

ACN that has been compiled from the development of verbal and visual attributes obtained as many as 10 attributes includes: (a) packaging gives the impression of fresh and quality product, (b) simple packaging design, (c) the color of the packaging is not too flashy, (d) easy to use packaging, (e) packaging has unique shape, (f) packaging does not take up space when stored, (g) packaging materials not easily damaged, (h) packaging can protect the product, (i) product-related information fully listed
on the outer packaging of the product, and (j) product information on the packaging easy to read and understand.

Based on the results of customer importance level measurement of those 10 attributes, it is found that attribute (d) has the highest level of importance and attribute (i) has the lowest level of importance in the development process of dehydrated strawberry packaging for e-commerce.

3.4. Planning matrix and WHATs priorities
The results of product performance level measurement indicate that all of the current packaging attributes have lower performance values than import, except for attribute (g). This shows that customers are satisfied with the current packaging materials which are not easily damaged compared to the import packaging. However, based on the overall results, current product packaging must be developed in order to be more competitive in the market.

The results of the improvement ratio and product performance level calculation as well as the value of future goals and sales points determination are then compiled in planning matrix. Meanwhile, in arranging the priority order of each WHATs attribute, it was found that the attribute with the largest normalized value of the customer importance level scale was attribute (j) and the lowest was attribute (c). Therefore, it can be concluded that the attribute of WHATs with the highest priority level to meet consumer needs in the packaging development process is attribute (j).

3.5. Technical needs (HOWs)
The arrangement of technical needs for the translation of 10 WHATs attributes resulted in 10 HOWs includes: (a) packaging visual design represents the product; (b) addition of window pack features; (c) application of simple, clean, and minimalist design themes; (d) addition of opening and closing features on the packaging; (e) adjustment of packaging form and product net weight; (f) addition of secondary packaging; (g) airtight and waterproof primary packaging; (h) packaging labels based on BPOM RI Regulations No. 31 2018; (i) font clearly legible; and (j) use of frequently used language.

3.6. Relationship matrix (WHATs and HOWs)
Analysis of the relationship between HOWs and WHATs in relationship matrix is carried out to find out how strong the relationship between technical needs and customer needs are. In addition, the analysis is carried out to assist in determining the priority order of technical needs to be made in the product packaging development process.

The results of the analysis show that there are 26 strong relationships, 12 moderate relationships, and 5 weak relationships between technical needs and customer needs. While the technical needs with the most relationship with customer needs is the addition of secondary packaging.

3.7. Correlation matrix (HOWs)
Analysis of the relationship between HOWs is carried out to determine the relationship between each of the technical needs that have been designed. The relationship between these technical needs can be either positive or negative. Technical requirements with a positive relationship indicate that these technical needs support each other, while a negative relationship indicates that these technical needs inhibit each other in the product development process carried out.

The results of the analysis show that there are 8 strong positive correlations and 7 moderate positive correlations. This shows that of all the technical requirements designed, there is no technical need that hinders the realization of other technical needs.

3.8. Technical needs matrix and HOWs priorities
The technical requirement matrix consists of determining the level of difficulty and calculating the priority of technical needs. Based on the results of discussions with the seller, the technical need with the highest level of difficulty is the addition of secondary packaging (quite easy) compared to other technical needs (easy and very easy).
While in arranging the priority order of HOWs, it is known that the technical needs with the highest percentage of normalization of priority are the technical needs of addition secondary packaging and the lowest is addition of opening & closing features on the packaging. Therefore, it can be concluded that HOWs with the highest priority to be carried out in the packaging development process is the technical need of addition of secondary packaging.

3.9. House of Quality (HoQ) matrix

All the results of six stages in product planning QFD analysis process that have been carried out are then inputted into the HoQ matrix according to the placement matrix. The HoQ matrix of dehydrated strawberry packaging development for e-commerce can be seen in Figure 2.

![Figure 2. Dehydrated Strawberry Packaging for E-commerce Development House of Quality Matrix.](image-url)

3.10. Result Analysis

Based on the HOQ matrix, it can be seen that ACN with the highest Importance Customer Level is attribute packaging can protect the product. This shows that customers want to receive the product intact with packaging characteristics that can protect the product. This attribute then translated into technical need addition of secondary packaging, which from the calculation results are technical needs with the...
highest priority level to be immediately realized in the packaging development process. This meets the standards of online sales product packaging [12], as of the product can be protected and safe until it reaches the customer. In addition, with the addition of secondary packaging, the development of visual and verbal attributes of the packaging can be focused on secondary packaging, as of product packaging can attract customers because of attractive packaging designs as product marketing tool [13].

However, after further calculations that have been carried out by considering other aspects of the calculation, ACN that has the highest priority to be realized immediately is attribute product information on the packaging easy to read and understand. By including complete product information on the packaging according to the packaging label requirements [11], product information must be easy to read and understand because product information has an important role in making product purchase decisions in e-commerce [15].

3.1. Packaging development concept

Based on the results of the QFD analysis related to the development of dehydrated strawberry packaging for e-commerce, from the technical requirements that have been prepared to meet consumer needs, a packaging concept can be made according to the results of the analysis. The visual design of the packaging can be seen in Figure 3 and the packaging used can be seen in Figure 4.

![Figure 3. Visual design of the outer packaging](image1)

(A): Front of packaging and (B): Back of packaging

![Figure 4. Dehydrated strawberry for e-commerce packaging concept](image2)

(A): Primary packaging [7], (B): Front of secondary packaging, and (C): Back of secondary packaging

4. Conclusions

1. Attributes of dehydrated strawberry packaging for e-commerce according to customer needs in order by priority are product information on the packaging is easy to read and understand, product-related information fully listed on the outer product packaging, packaging gives the impression of a fresh and quality product, packaging can protect the product, packaging is made

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from materials that are not easily damaged, the packaging design is simple, the packaging is easy to use, the packaging does not take up too much space when stored, the packaging has a unique shape, and the color of the packaging is not too flashy.

2. The technical needs that must be done in developing dehydrated strawberry packaging for e-commerce in order of priority are the addition of secondary packaging; adjustment of packaging form and product net weight; application of simple, clean, and minimalist design themes; packaging labels based on BPOM RI Regulations No. 31 2018; airtight and waterproof primary packaging; the font is clearly legible; use of frequently used language; addition of window pack features; visual packaging design represents the product; addition of opening and closing features on the packaging.

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