

Experimental Design of Durian Fruit in Packaging for Export Needs Using Taguchi Method

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Abstract:- This Paper on “Experimental Design of Durian Fruit in Packaging for Export Needs Using Taguchi Method” Taguchi experimental design is a statistical method that functioned as a tool in order to improve and improve the quality, so that changes to the variables of a process or system is expected to give optimal results (response) is quite satisfactory. So this study aims to analyze the existing literature on the design of taguchi experiments on durian fruit to determine the best packaging for export durian and mapping articles. The method used in this study is the taguchi method and ujiorganoleptik conducted by following the procedure and followed by analysis to see the linkage in the published article. This study used VOSViewer as software and use Publish or Perish to help grouping data. The results of the study on food packaging design and design experiments VOSViewer on co - authorship does not show the dominance of the name of a particular author in research related to food packaging design and design experiments while the co - VOSViewer co-in the event found opportunities opportunities product, customer, performance has a high enough linkage value. has a fairly high linkage value.

Keywords:- Component; Taguchi; Durian Export; Packaging; Organoleptic Test, Food Packaging.

I. INTRODUCTION

Durian is a seasonal tropical fruit that has high demand and high value in foreign markets¹. Besides Thailand, Malaysia, Indonesia, and the Philippines are also major producers of durian². Durian (*Durio zibethinus* Murr.) is one of the most popular and desirable fruits in Southeast Asia due to its high nutritional value and unique flavour which has been shown to have significant antioxidant, antiproliferative, anti-inflammatory, antibacterial, anti-hyperglycaemic and

anti-cholesterol effects³. Durian fruit is highly desired by consumers for its quality characteristics such as pulp colour, texture, sweetness, bitterness, and aroma⁴. Durian (*Durio zibethinus*) is a plant that grows in tropical countries which makes a delicious fruit much favoured by many people. Durian is usually marketed fresh with different price levels. In general, durian fruit is consumed fresh and after being processed into finished products. Durian fruit is a seasonal and climacteric fruit, and its season usually lasts from June to August and December-January. Due to improper handling for marketing and storage conditions during the durian season, On the other hand, overripe fruits tend to spoil quickly making them unfit for sale affecting consumer perception. Although several studies have been conducted to detect the stage of ripening in durian, the methods are mostly destructive such as damaging the pulp and carotenoid content using routine analysis or minimally damaging in terms of desirable texture due to the pointed surface of the fruit. The high market demand and lack of supply in the off-season contribute to the increase in durian prices in addition, durian has a short shelf life⁵. Durian tends to deteriorate or rot between 20%-25% as the fruit continues to ripen or breathe even after harvest. In addition, durian fruits are reported to have a very limited shelf life of between three to four days.

Based on data from the Belawan Agricultural Quarantine, the Ministry of Agriculture recorded 441.1 tonnes of durian exports from North Sumatra amid the coronavirus pandemic or until the first semester of 2020. Durian is exported to China and Malaysia. "There is an increase in durian exports amid the current coronavirus pandemic. Malaysia and China really like North Sumatra durian. Last year, durian exports reached 521.6 tonnes. Until the second semester, 441.1 tonnes," (Head of the Belawan Agricultural Quarantine Center Hasrul, 2020), China imported 249.2 tonnes of durian from North Sumatra with a total of 19 quarantine document certifications. Meanwhile,

³ Lisa Striegel et al., “Durian Fruits Discovered as Superior Folate Sources,” *Frontiers in Nutrition* 5, no. November (2018): 2–6, <https://doi.org/10.3389/fnut.2018.00114>.

⁴ Xue Yi Tan et al., “Effect of Freezing on Minimally Processed Durian for Long Term Storage,” *Scientia Horticulturae* 264, no. December 2019 (2020): 109170, <https://doi.org/10.1016/j.scienta.2019.109170>.

⁵ N. A. Razali et al., “Cryogenic Freezing Preserves the Quality of Whole Durian Fruit for the Export Market,” *Food Research* 6, no. 3 (2022): 360–64, [https://doi.org/10.26656/fr.2017.6\(3\).428](https://doi.org/10.26656/fr.2017.6(3).428).

¹ S. Somsri, “Production, Diversity and Utilization of Durian in Thailand,” *Acta Horticulturae* 1186 (2017): 1–13, <https://doi.org/10.17660/ActaHortic.2017.1186.1>.

² Mu Tan Luo et al., “Efficient Using Durian Shell Hydrolysate as Low-Cost Substrate for Bacterial Cellulose Production by *Gluconacetobacter Xylinus*,” *Indian Journal of Microbiology* 57, no. 4 (2017): 393–99, <https://doi.org/10.1007/s12088-017-0681-1>.

Malaysia imported 190.9 tonnes with 13 shipments. "North Sumatra durian is exported in frozen form (paste), which is packed in airtight plastic and stored at minus 15 to minus 20 degrees Celsius so that the quality of durian remains good and safe for consumption.". Besides the problem of storage and durability of durian fruit, the selling price also fluctuates greatly according to the harvest season. If the harvest is simultaneous throughout the region, the selling price at the farm level is very low and vice versa if the harvest is not together the price will increase but the selling price at the farm level has not been in favour of farmers⁶. Durian (*Durio zibethinus* Murray) is a popular seasonal fruit in Southeast Asia. Considered the 'king of fruits', durian is distinguished by its large size, pungent odor, and thorn-covered skin. The quality of the pulp varies greatly, and it cannot be determined from the outside. Some physiological disorders greatly degrade the quality, including granulation of the pulp, browning of the inside of the pulp, wet core problems and tipburn. Fruits become soft, turn slimy and quickly deteriorate, resulting in an unpleasant taste and pungent odor. One of the fruits is located in a smooth, tender pulp of yellow or white color with a strong taste. Today, musang king durian is the most popular variety for both local and export markets⁷

Whole fruit export, which is currently a common practice, has the challenge of post-harvest loss mainly due to high physiological changes, disease/insect infestations, and deterioration⁸.

There is one phenomenon when shipping durian abroad or domestically During transportation, there is a very pungent aroma caused by the wrong type of packaging material and packaging method. Packaging serves to protect a commodity product from physical, mechanical, and microbiological damage, besides that the function of packaging is also to create attractiveness for consumers, desire for consumers, and provide added value to the product; and extend product shelf time. this end of fresh fruit export research aims to facilitate the grading of Prime quality fruit. In this point of view, methods for non-destructive quality evaluation have been developed using image processing, visible light, near infrared (NIR) reflectance and ultrasonic. While some studies have given good results, the application of the new technique is in the hands of the commercial side.⁹ The Durian skin, which is the main part of the fruit, produces high levels of

ethylene gas and further induces the ripening and aging process of the fruit. The durian skin, which comprises about 70% of the total weight of the fruit, is an agricultural waste and a hidden disease part, leading to increased logistics costs. In addition, the skin of the fruit, which contains many external Thorns, is a major obstacle in packaging and handling logistics. Thus, minimal post-harvest durian processing is a modern and robust packaging alternative, fresh cut, however, is perishable and can have a shorter shelf life, in particular if processed with improper modified atmosphere (MAP) packaging procedures¹⁰. For the simulation of logistics procedures for the European market, the storage temperature range of fresh durian is between 4 °C and 10 °C (as found in personal interviews with export companies). The respiration behavior of fresh durian at 4 °C and 10 °C was then improved in the breathing model for MAP in order to optimize the rate of micro perforation in pet/PE laminated film¹¹

To overcome the above problems and support the government's efforts to increase farmers' income and living standards, it is necessary to find the most efficient and effective type of packaging material in the packaging of durian fruit to be sent abroad or domestically or even to the hands of consumers, therefore the authors want to research the Experimental Design of Peeled Durian Fruit in packaging for Export Needs with the Taguchi Method.

II. RESEARCH AND METHOD

Systematic literature review is applied to replace the field mapping method and is used to find out the latest research series needed to analyse published journals to answer some specific research. The Systematic Literature Review (SLR) method follows an established procedure and allows the literature review process to avoid subjective preferences and understanding. This method uses meta-analysis to look at statistical distributions and relationships in published articles. In this study, researchers used VOSViewer and Publish or Perish software for data clustering.

The literature review carried out is Figure 1. Paper Selection Process scheme by looking for the theme of taguchi experimental design and export durian fruit packaging which is used as a keyword in the search on Publish or Perish software. In Publish or Perish there are two search engines used, namely Google Scholar and Scopus. Furthermore, it contains several limitations in the journal search process such as research articles, the number of journals to be displayed and journal years ranging from 2017 to 2023. The next step is to conduct a search process using the keywords taguchi experimental design and durian export packaging. The total

⁶ Kasma Iswari, "PENINGKATAN NILAI TAMBAH KOMODITAS DURIAN MELALUI TEKNOLOGI PENGOLAHAN HASIL Kasma Iswari," *Jurnal Sainns Agro* 6, no. 2 (2021): 9–16.

⁷ M. N. Latifah et al., "Processing and Handling of Fresh-Cut Tropical Fruits," *Acta Horticulturae* 1141 (2016): 91–102, <https://doi.org/10.17660/ActaHortic.2016.1141.9>.

⁸ Petcharatana Booncherm and Jingtair Siriphanich, "Booncherm, Siriphanich - 1991 - Postharvest Physiology of Durian Pulp and Husk.Pdf," *Kasetsart Journal (Nat. Sci. Suppl.)*, 1991.

⁹ H. K. Purwadaria, "Research and Development for Quality and Safety of Fresh and Fresh Cut Produce in Indonesia," *Acta Horticulturae* 875 (2010): 243–50, <https://doi.org/10.17660/ActaHortic.2010.875.30>.

¹⁰ Jirutthitikan Boonthanakorn et al., "Quality Preservation of Fresh-Cut Durian Cv. 'Monthong' Using Micro-Perforated PET/PE Films," *Food Packaging and Shelf Life* 23, no. July 2019 (2020): 100452, <https://doi.org/10.1016/j.fpsl.2019.100452>.

¹¹ Booncherm and Siriphanich, "Booncherm, Siriphanich - 1991 - Postharvest Physiology of Durian Pulp and Husk.Pdf."

results obtained were 1620 journals with details of google scholar as many as 500 journals and scopus as many as 1120 journals. The next process is the selection process by reducing several journals and finding relevant journals using the keywords durian export, export packaging, and taguchi method experiments more for durian by reading titles and keywords. Journals that do not fit the criteria will be eliminated. Next, read the abstract of each journal, which if

the journal is relevant to the theme to be studied it will be included while journals that do not match the criteria will be eliminated again. The next process is to read the journal as a whole to find more complex relevance to the theme under study. After reading all the journals, the remaining journals are used in the literature review process. And the last stage is to determine the results and conclusions drawn from the literature review process.

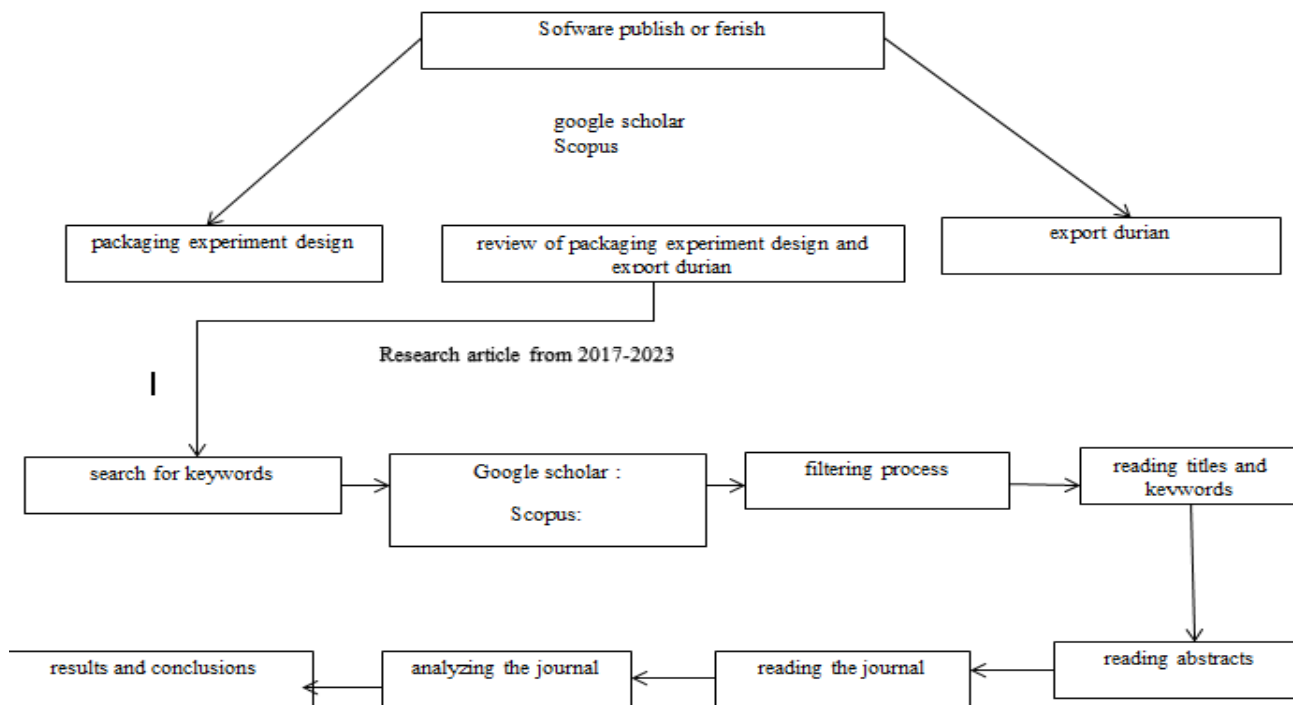


Fig 1. Paper Selection Process Chart

Bibliometrics directs quantitative research that has been produced in journals in certain fields. Bibliometric analysis is a method of measuring literature using statistical means, so it falls under the application of quantitative analysis. Bibliometric analysis explains the approach of future research in a predetermined field. A total of 60 article files were entered into the VOSViewer software. This data contains information about each article, such as author, title, year of publication, doi, abstract, affiliation, keywords, references, and journal.

Clustering is one of the ways used for data grouping. Clustering is the process of classifying data into several clusters or groups so that data in one cluster has the greatest similarity, and data between clusters has the least similarity.

Data categorization is the most effective method to find out and observe the proposed topic. Data clustering supports infrastructure discovery, natural clustering, and data compression. In this research, journal clustering is based on co-occurrence and co-authorship.

Co- currence based clustering is used to find the relationship and similarity of some items (words, phrases) in several documents in one document of the analyzed data set. While clustering based on co-authorship is used to find the

relationship of various studies based on research documents provided by researchers.

III. RESULTS AND DISCUSSION

The co-authorship network is a guide for cooperation in research and strategies that can be used to improve the quantity and quality of scientific publications. To see the form of the author's network used "social network analysis " which prioritizes the interaction that occurs between related researchers. Co-authorship analysis is used to find relationships between different studies based on research documents provided by the researchers. In research related to packaging experiment design and export durian has been used 60 research journals. In the next step, use VOSViewer software to perform co-authorship analysis with the specification of the analysis unit to be addressed is "authors". In the next step, use VOSViewer software to perform co-authorship analysis with the specification of the analysis unit to be addressed is "authors". The results of co-authorship that has been done on vosviewer software are shown in Figure 2 . Furthermore, from the results of data processing using vosviewer software, visualization results obtained from 60 journals obtained clusters including 1 cluster with 60 items that have been selected. Figure 2 describes the cluster

showing the relationship between the author (Berg C.J., Duan Z.,) and other authors netted in the cluster.

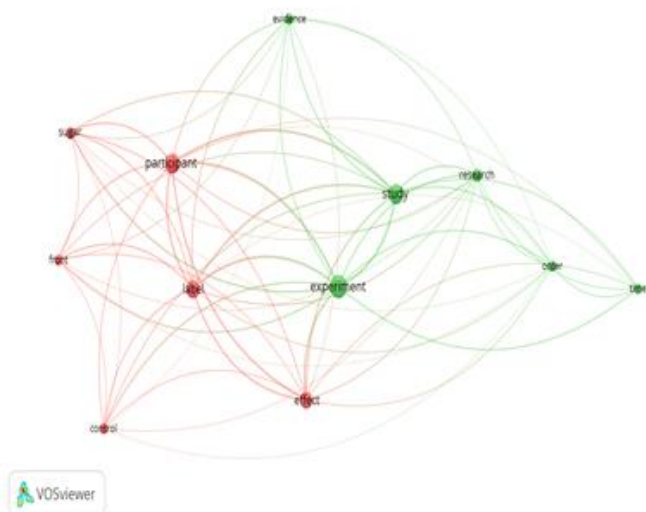


Fig 2: relationship between writers

The larger the node size, the more often the author's name appears in the dataset, or means the cluster in the analysis output co-authorship an author prioritizes on a particular research topic because he has a strong network of writing relationships with other authors. To show the dominance of citation journals in 60 journals that have been focused, data collection was carried out by looking at various citation indices from each Journal, which will then be analyzed in VOSViewer using Co-occurrence Analysis. Co-occurrence Analysis itself is used to find the relevance and various similarities of several items such as words or phrases from several documents from various data sets to be analyzed. This analysis was conducted on 60 selected journals with the specification of Journal analysis units in the form of "keywords" and the number of keyword occurrences at least once. Thus obtained 4 clusters with 60 items selected from the visualization. The output of the co- current analysis can be seen in Figure 3 .Until all the clusters that have been visualized have a close relationship with other clusters. Then we can see in Figure 3 that the word "food packaging has a larger node than the word "consumer so that the word" food packaging" has External links such as packaging design, consumer, food, buy, product, and so on. So the larger the node, the higher the frequency of words that will appear in a cluster.

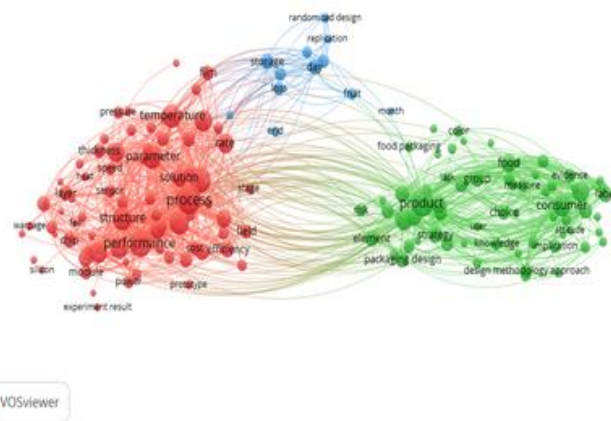


Fig 3: Co-occurrence Output

Packaging serves to protect a commodity product from physical, mechanical, and microbiological damage, besides the function of packaging is also to create attraction for consumers, desire for consumers, and provide plus value to the product; and extend the shelf life of the product. To overcome the above problems and support government efforts in increasing the income and living standards of farmers, it is necessary to find a type of packaging material that is most efficient and effective in packaging durian fruit to be sent abroad or domestically or to the hands of consumers

Research methods are closely related to the type of research used. Based on 60 types of research journals, descriptive analysis is carried out by compiling the methodology used in each journal such as framework & conceptual, empirical studies, modeling, and conceptual performance.

Table 1 List of names of researchers and number of publications

<i>List of names of researchers</i>	<i>number of publications</i>
Latifah, M.N.	4
Somsri, S.	3
Jatuporn, C.	3
Ab Aziz, I.	2
Zaulia, O.	2
Thongkaew, S.	2
Talib, Y.	2
Sukprasert, P.	2
Siti Aisyah, A.	2
Sirisomboon, P.	2
Rueangrit, P.	2
Razali, M.	2
<i>List of names of researchers</i>	<i>number of publications</i>
Nur Aida, M.P.	2
Ketsa, S.	2
Joanna, C.L.Y.	2
Hairiyah, M.	2
Fauziah, O.	2
Abdullah, H.	2
Zhang, H.	1
Zaipun, M.Z.	1
Zainab, Y.	1

Yahia, E.M.	1
Wongsaisuwan, M.	1
Wongs-Aree, C.	1
Wisutiamonkul, A.	1
Wiangsamut, B.	1
Wattanamongkhon, N.	1
Wanaset, A.	1
Wan Ibrahim, W.M.	1
Wan Husin, W.M.R.I.	1
Vichukit, V.	1
Vichitrananda, S.	1
Tongchure, S.	1
Tinwong, C.	1
Thongbai, J.	1
Thiyajai, P.	1
Thanomvech, P.	1
Terdwongworakul, A.	1
Tantrakoonsab, W.	1
Tantrakoonsab, N.	1
Tan, X.Y.	1
Swangpol, S.	1
Suwanajote, N.	1
Suwanajote, N.	1
Suvanvihok, V.	1
Suanpang, P.	1
Sridonpai, P.	1
Sittisom, W.	1
Singh, S.P.	1
Setyadjit	1
Setyabudi, D.A.	1
Safari, S.	1
Saenphon, C.	1
Saengprachatanarug, K.	1
Ruwaida, A.W.	1
Rosly, N.K.	1
Rizvi, Q.U.E.H.	1
Rittiron, R.	1

Table 1 above shows some penulisateur dominant researcher used as a case study in this study, namely Latifah, M.N., because as many as 4 journals have conducted research or research related to food packaging and packaging design and case studies.

So from the results of this study obtained the mapping results of several previous studies that will be the next research opportunities. And based on bibliometric analysis does not show the dominance of the name of a particular author in research related to the topic of food packaging and packaging design there are several opportunities for renewal and food packaging and packaging design have a high relationship.

IV. CONCLUSION

Based on the results of the study, it can be concluded that bibliometric analysis can help researchers in seeing various studies and research advantages. Based on the results of the analysis of the output of vosviewer on co-authorship does not show the dominance of the name on a particular author in research related to food packaging design and export durian while in co-occurrence vosviewer found the opportunity of product, customer, performance has a high enough linkage value. Based on the results of descriptive analysis and analysis results using Publish or Perish software, it was found that 1620 journals were then analyzed again by looking for title links taken so that 60 journals had links with themes taken based on the range of 2017 to 2022. Of the 60 journal titles taken, so that the contribution of this literature review is obtained by mapping the journal based on the author, the location of the case study that dominates, so that updates will be obtained for further research. Further research is expected to be developed again for other countries that buy the review of previous papers. This study provides an in-depth analysis and synthesis of the pool of knowledge so far generated in the field of food packaging design. Our study largely confirms the trend of export fruit and extends to recent years ranging from 2017 to 2022. Our review analyzes the meaning of food packaging and related concepts, its basic properties, the steps to define the strategy and the components contained in food packaging design. Our analysis also explores the relationship between food packaging design and taguchi's experiments and durian exports this study provides a clear picture of the direction in which a growing number of innovation and marketing companies are looking to integrate environmental sustainability into their strategies on how to develop and implement Food packaging design, Furthermore, this review highlights several issues that seem relevant in more than one element of food packaging design and durian experiment design In terms of implications for students, this research, by integrating existing studies on the topic, provides a comprehensive theoretical framework, and, by highlighting aspects not adequately addressed in the existing literature, suggests directions for future research.

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