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Nira Water Bottle Design in a Bid to Elevate Malaysian Coconut Industry

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Abstract - *The coconut stands as the fourth most important industrial crop in Malaysia. It produces a myriad of products including nira water, usually involves the use of plastic bottles. Data collection was initiated by literature reviews, followed by direct observations and interviews to gather additional information relevant to the research. Three main issues were identified, namely accelerated fermentation process, nira water sours rapidly and rainwater seeping into nira water. Design process started with the establishment of design statement, followed by the criterias of design, namely aesthetics, product function, and ergonomics. Ideas and basic principles of nira water bottle product were brainstormed at Design Conception stage, progressing to its amalgamation into a single design at the Design Embodiment stage. The next stage is Selected Design, where the researcher produced rendering, detailed drawing and full-scale model. Details of proposed materials and production process were also prepared. Design process was completed with nira water bottle design appreciation via Feldman theory that comprises of four steps, namely description, analysis, interpretation, and evaluation. With this new nira water bottle design, it is hoped that the issues faced by nira water entrepreneurs in Malaysia could be somewhat mitigated. Hopefully this research will be a step forward in enhancing and upgrading the Malaysian coconut nira water industry, which is now seen as a potential source of wealth for the country, in addition to be on par with the world's leading producers of nira water.*

Key Words: nira water, coconut industry, bottle design, design process, Malaysia.

1. INTRODUCTION

The coconut or known in Malay as kelapa (Cocos nucifera L.) is a species of palm that thrives in humid tropical areas. As reported by R.Sudha et al [11], this plant may have originated in the Southwest Pacific or the Indian Ocean and was introduced to Malaysia and the islands between South East Asia and the Western Pacific before it entered more than 90 countries. India is the top global coconut-based product producer. Other main producers include Indonesia and the Phillipines.

In Malaysia, coconut stands as the fourth primary industrial crop after oil palm, rubber, and paddy. Currently, annual Malaysian coconut production is 504,700 metric tonne per year, with planting acreage of 84,600 hectares. The latest statistics cited Sabah as the state with largest planting area, followed by Sarawak, Johor, Selangor and Perak [10].

The diversity of coconut products is so outstanding that it was referred as the tree of a thousand use (tree of life). This is because almost the entire coconut plant parts like its trunk, leaves, fruit, fiber and water can be utilized and taken advantage of. Throughout Malaysia, young coconut water is an important commodity that serves as an isotonic drink due to its energy boosting and toxin removal properties. Young coconut water is also made into popular drinks such as coconut shake, while its flesh is eaten as it is or used as ingredients in "kuih-muih" and biscuits.

Nowadays, Malaysian enjoy nira water as a natural drink in addition to young coconut water. Nira water is a sweetened drink extracted from the coconut tree or nipah palm. The production process of coconut nira water and nipah nira water are similar, with the slight difference being coconut nira water is extracted from the coconut bunch stem atop the tree while nipah nira water is collected from the fruit stem located at the base of the nipah plant (See Fig. 1 and Fig. 2). Both nira water can be enjoyed fresh, when processed into “tuak”, or turned into sweetmeats (gula Melaka or gula kabong). Pricewise, it is unregulated and usually depends on the seller, which can range from RM10 to RM15 per liter and RM50 to RM60 per 10 liters [1]. According to Anim Hosnan [2], fresh nira water will traditionally be sold at RM 2.00 - RM 3.00 per plastic container or per small bottle (approximately 180 - 250 ml).

The exact number of direct nira entrepreneurs in Malaysia is unknown. According to the statistics provided by Anim Hosnan [2], in 2012, around 150 - 250 entrepreneurs were estimated to be involved in nira water production activities, with a production estimate of approximately 30,000 - 50,000 liters annually. Meanwhile, Omar Osman and Nur Syazwana Mansor [8] reported the existence of 36 nira entrepreneurs in Kedah and 9 in Perlis in 2015.

Fig -1: Nipah bunch stem **Fig -2**: Coconut bunch stem

Coconut nira water potential in Malaysia is bright, since statistics showed an increase in coconut's downstream product demands from local and abroad consumers. The Government of Malaysia, through the Ministry of Agriculture and Agro-based Industry (MOA), has allocated almost RM50 million to the development of the coconut industry, which is now seen as a potential source of new wealth for the country. Much of the country's coconut revenue comes from smallholders (95%). MOA aims to increase coconut production from 550,000 mt (550 million seeds) in 2010 to 1.2 million mt (1.2 billion seeds) by 2020 with an annual growth estimate of 8.7% [9].

To stimulate the Malaysian coconut industry, special allocations will be provided and implemented systematically, encompassing programs such as coconut production enhancement and select high-yielding coconut seed variety productions. In addition, recent work by coconut industry associated agencies has successfully developed hybrid coconuts such as Marleca, Myleca, Careni, Careca, Marena and Mylag, which would eventually lead to the production of new coconut varieties in the future years [10].

2. PROBLEM STATEMENTS

Based on the researcher's observation and experience, coconut nira water will be extracted and collected in plastic bottles also known as tukir. Collected nira water quality are usually determined based on its sweetness and freshness. Coconut nira water has always been in high demand among Malaysians, as there are many benefits to be gained from its consumption. According to Farizul Izwany [4], coconut nira water had 13 nutritional benefits, including constipation and stomach pain relief, to minimize fever, strengthen muscles, strengthen the body, and provide warmth to the body of the drinker. It is also said to prevent osteoporosis, boost milk production and reinforce the muscles and cells of the body. Dharmakesuma [3] said that coconut nira water is proven to possess extraordinary nutritional benefits and has high commercial value. A gamut of products can be created via coconut nira water with just a fraction of the cost. He also added that in countries like Indonesia and the Phillipines, the industry is vigorously developing, although not quite the case for Malaysia. In Malaysia, especially in its East Coast region (Kelantan, Terengganu, Pahang), coconut nira water shows an incredible increase in demand especially during hot weather spells and the advent of fasting month. According to Noorazura Abdul Rahman [7], hot weather ravaging states north of Malaysia is a blessing in disguise since it caused the revenue from coconut water and nira sales to increase more than trifold. According to her, the sales of both reached RM1,000 per day compared to the meager RM200 prior. Coconut nira water that was being sold at 50 packs per day saw an increase in sale that can reach up to 160 packs daily. Most consumers interviewed relegated the punishing weather that rapidly causes lethargy and thirst as the driving force behind the nira water purchase to quench their thirst. A report by Harian Metro [1] showed that during the holy month of Ramadan, doubling demands for coconut nira water enabled a seller from Kampung Baru Rhu Muda, Marang, Terengganu to rake in more than RM3,000 throughout the month. This is because 15 days prior to Ramadan, merchants across Pahang and Kelantan would place orders for their business endeavors during the holy month. For ardent consumers, they are more than happy to drop by at the nira entrepreneur place at their earliest just to secure nira water for breaking fast. To ensure that all demands are met, coconut nira water seller had to limit the purchase for each consumer. This high demand for nira water encourages more seller to jump into the Ramadan nira business bandwagon.

Referring to the above scenario, we can obviously see that coconut nira water demand will increase yearly. The industry is also perceived as having the potential to develop widely soon, in line with the increasing demands as seen in our neighboring countries Indonesia and the Phillipines.

Although there is an increasing demand for coconut nira water as described above, the industry's entrepreneur seems to never seek to improve let alone enhance the system or nira collection process quality. For example, they still use plastic bottles that is clearly not tailored for nira collection activities to extract nira. Most of these bottles were mineral water bottles, carbonated water bottles or containers to keep water in. To be fair, the use of plastic bottles is quite recent for vessels made of bamboo stems known as "tukir" were used prior to this.

Fig -3: Bamboo stems (tukir) **Fig -4**: The use of plastic bottle

The use of plastic bottle is also deemed more practical by nira water entrepreneurs as it enables them to see the progress of nira water collection that consequently aid harvesting time determination.

The use of plastic bottle as nira water collection vessel presented numerous issues as most bottles utilized have exceeded their recycling dateline and can pose harm when used. In addition, the bottles break easily, are slippery, not ergonomic and are not practical to be employed as a nira water container.

Following the discussion above, this research was suggested to analyze and identify a more practical nira water bottle design for Malaysian nira water entrepreneur use. This research was also suggested as a step forward in enhancing and elevating Malaysian coconut nira water industry in a bid to make it on par with the world's leading producers of nira water. This title has also been a priority for the researcher since, to date, no organization or individual has appeared to carry out any research or study related to these subjects.

3. RESEARCH METHODOLOGY

To obtain the latest and true information pertaining to the research, information and data collection was carried out by the researcher according to the processes as follows:

3.1 Literature Review

The literature review was done by referring to trusted sources such as books, magazines and journals. In addition, internet sources were also employed via conferring to research-relevant web sites. Apart from compounding information on coconut nira water, this literature review also successfully gathered information in identifying the most appropriate material for nira bottle design manufacturing. The proposed material will be a part of the material and manufacturing process of the new nira bottle design. In the literature review, it was found that generally there are 6 main materials involved in the manufacturing of today's bottle, which are 1) plastic (example: PET, HDPE, PP, Polycarbonate), 2) glass, 3) silicone rubber, 4) aluminium, 5) paper, and 6) clay. Based on the research conducted, the most appropriate material for nira bottle design is High-Density Polyethylene (HDPE), supported by these reasons:

1. Did not initiate any chemical reaction with the materials stored inside, especially nira water.
2. An environmentally friendly material since it is recycleable.
3. Long shelf life with cost-effective production

3.2 Direct Observations

Direct observations were performed by closely observing the behaviors, tendencies, movements and actions of nira entrepreneurs while they were climbing the coconut trees and replacing used bottles. Camera recordings were done to record all activities for reference purposes and as evidence, as shown in Fig. 5 to Fig. 8.

Fig -5: Ready for nira

Fig -6: Climbing the Collection coconut tree

Fig -7: Nira water bottle

Fig -8: Collected coconut in operation nira water

3.3 Interviews

Interviews with nira water entrepreneurs were conducted to gather additional information in relation to the yet to be designed nira bottle.

4. IDENTIFIED CHALLENGES

Through direct observations and interviews conducted by the researcher involving nira water entrepreneurs, three main issues were identified, which are:

1. Rapid fermentation process

Malaysia is a tropical country with daily temperature ranging from 25 to 35 degree Celsius throughout the year. This hot and humid weather entrap hot air in nira bottles, thus accelerating the fermentation process.

2. Nira water sours quickly

Unclean nira bottle causes a spike of microorganisms in the fermentation process. The increase of microorganism accelerated nira water fermentation process causing the production of large amounts of lactic acids, causing the nira water to become sour.

3. Nira water mixed with rainwater.

Malaysia is one of the countries in Asia that is affected every year by the Southwest Monsoon and the Northeast Monsoon. This unpredictable climate proves to be the main challenge for nira water entrepreneurs. This is because, during the monsoon, the bottle of nira water are prone to crack and the nira water quality is also compromised because it is mixed with rainwater.

5. PROBEM SOLUTION RECOMMENDATIONS

The future nira water bottle design should consider the three main issues discussed above, together with other product design related matters.

Hence, to achieve the objectives of this study, the following suggestions should be treated as the basis for the upcoming design process considerations:

- Functionality – to prevent rapid fermentation process due to extremely hot weather.
- Ergonomics – considering nira entrepreneurs' activities during tree climbing and replacing used bottles.
- Safety – developing a suitable method for nira entrepreneurs to harvest nira hands free.
- Material – suggesting an environment friendly material, that have long shelf life and low cost.

6. DESIGN PROCESS

6.1 Initiating the Design Process

The design process was started by setting the design statement, objectives, design criteria, and target user as described below:

- Design Statement

To create a practical coconut nira water bottle design employing contemporary eco-concept for Malaysian nira industry use.

- Design Objectives
  - To propose a nira water bottle design that can prevent fermentation process due to Malaysia's hot climate.
  - Overcome ergonomic problems when using bottles during the nira water collection process.
  - Recommends a suitable material for environmentally friendly and low cost nira water bottles
- Design Criteria

Based on the suggestions by Marzuki Ibrahim (2013) as follows:

- Aesthetic – forms perceived from the angles of style, appearance and finishing quality, beautiful material (a delight to see), captivating colors, and pleasing appearance (soft surface, comparison rate, dynamics, simplicity, detailed).
- Product Function – practical to use, functions well and effectively, and has additional functions.
- Ergonomic – provides physical comfort, easy to use with minimum lethargy effects.

- Target User

The nira water bottle design is targeted to entrepreneurs directly involved in Malaysia's nira water production, especially in the East Coast states of Kelantan, Terengganu and Pahang.

7. DESIGN CONCEPTION

It is a process to come out with several ideas and basic principles of nira water bottle product. Each idea includes several particular details intended to clarify the elements of a given idea or concept. Several concepts of nira water bottle was produced, taking into account the design criteria set by the researchers. The sketch was manually produced via various medias like pencil, pen and marker. The produced concept will be studied, criticized, and evaluated by a group of researchers in order to determine its compliance with the previously set design criteria. Concepts matching the criteria set will be considered, chosen and further developed in the next stage, which is the Design Embodiment stage.

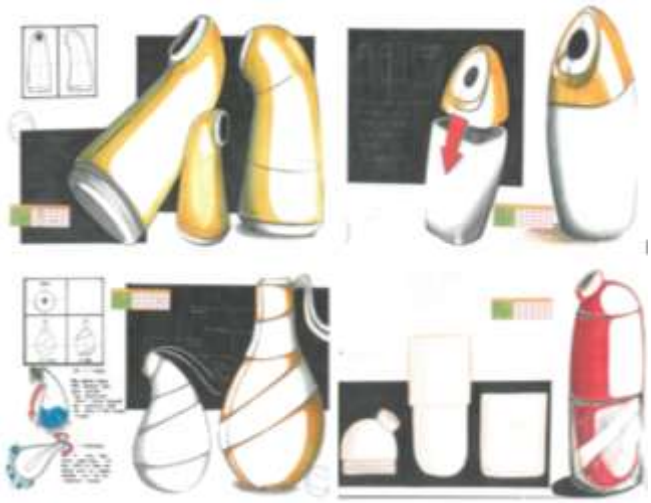

Fig -9: Several concepts of nira water bottle

8. DESIGN EMBODIMENT

At this stage, several selected concept ideas from the previous stage (Design Conception) will be developed and its form, size, style, appearance and such will be determined, bearing in mind the basic functions and processes of nira water outer bottle form manufacturing. Developed ideas will be evaluated and if needed the ideas will be amalgamated into a single design of choice as desired. The researcher will also create a general production drawing to determine the real form and dimension. A mock-up was developed to ascertain its appearance, form, size, production process and ergonomic. Before the completion of this stage, all design details appearing to be troubling or uncertain must be addressed by

the researcher. The general projection drawing will be fully completed, so as the preparation of detailed information regarding nira water bottle design to ensure the smoothness of execution for the next stage, Selected Design.

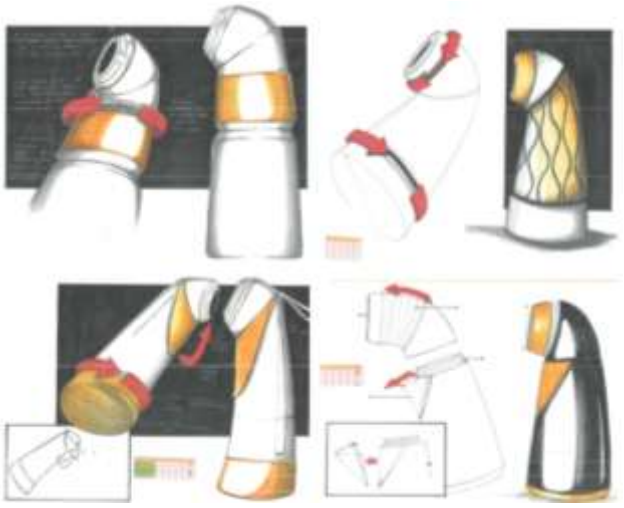

Fig -10: Development of ideas

Fig -11: Mock-up (left) and technical drawing (right)

9. SELECTED DESIGN

At this stage, nira water bottle design, its dimension, material selection and production process will be determined. The researcher's error and research group's error in determining these details will result in several problems that could hinder the designing process and ultimately result in the failure to achieve the objectives of this research. To paint a clearer picture of the selected nira water bottle design, the researcher produced a concept render or rendering. It was drawn in an orderly manner, with the focus afforded to the precision of form, architecture, material and color so that it can be spontaneously understood to first time viewers. Apart from that, a detail drawing that explained the dimension, tolerance, and production method suggestion was also created. Full scale model establishment was produced by the researcher at this stage, along with several ergonomic elements settings. Proposal details pertaining to the materials and production process was also perfected.

Fig -12: Nira water bottle rendering

Fig -13: Full scale model

10. DESIGN APPRECIATION

The appreciation process was conducted by the researcher and the research group at the end of the design process, aiming to appreciate the values of a product design formally. Although there is no model or specified sequence for product appreciation in the context of product design, there is a specific sequence introduced by Feldman in 1970 [5]. He proposed four steps of appreciation, namely 1) description, 2) analysis, 3) interpretation, and 4) evaluation. Feldman insisted each step to be performed in the set sequence so that a comprehensive and precise explanation can be obtained, from the initial step (description) to the final one (evaluation). To perform the appreciation process on the nira water bottle product design, four steps as suggested by Feldman was adapted, as described below.

10.1 Description

This nira bottle design employs eco-contemporary concepts, a modern yet contemporary design that did not compromise the eco-friendly aspect of creating a stylish and up-to-date style. This concept is embodied in a simple yet attractive form of environmental-friendly media. It is offered

in the mix of black, yellow, and grey, to highlight the design's uniqueness. The media used is High-Density Polyethylene Polymers (HDPE), a lightweight material that is easy to manipulate, has strength and durability, and is recyclable.

10.2 Analysis

This nira bottle is designed to prevent rapid fermentation due extremely hot weather, while considering the ergonomic factor of nira entrepreneur during nira collecting activities and safety factors. To prevent fermentation process, it is suggested the nira bottle to be made of High-Density Polyethylene Polymers (HDPE) material, since it can withstand hot weather in addition to being environmental-friendly and recycleable. Ergonomic factor was incorporated through the size of the bottle, where it is appropriate with the usage and comfortable to hold. As for safety factor, the nira bottle is equipped with silicone rubber to prevent slippage and add grip while being held.

10.3 Interpretation

The nira bottle design clearly showed that it was intentionally designed for the use of nira water industry in Malaysia. The product is designed with in-depth research on fermentation, ergonomics, and user comfort during its usage. In addition, the safety aspect is also adopted by adding a system that enables the nira water entrepreneur to held the bottle hands free during nira collection process. What makes this product unique is the use of environment-friendly material, High-Density Polyethylene Polymers (HDPE), that has a long shelf life and low production cost. Through the usage of this material, the nira bottle product will not harm our ecosystem or the environment, in fact it will contribute to life or green practices that helps the conservation of sources such as water and energy.

10.4 Evaluation

The design of nira bottle product using eco-contemporary concept such as this is a successful product. Apart from its outer design that appears unique, captivating, and with the best and latest style, it did not abandon the purpose of its design. Among others, this product was designed as an answer to the questions regarding the problems of fermentation process, ergonomic aspects, and safety. These issues are solved by the introduction of heat-resistant material, the introduction of appropriate bottle sizes and the use of silicone rubber. In addition, this design is an example of successful product design due to its innovative design that is in line with the latest manufacturing technology, with its contribution to green practices that help to protect the environment.

11. CLOSING REMARKS

The researcher believes that the design of the coconut nira water bottle proposed above can be appropriately considered by stakeholders, especially those directly involved in the Malaysian coconut industry, like the Ministry of Agriculture and Agro-based Industry (MOA). The researcher is also confident that the introduction of this new nira water bottle design of the best and latest style has provided an answer to the problems related to fermentation process, ergonomics aspects, and user comfort that have been long haunting the Malaysian nira water entrepreneurs. To wrap it up, it is hoped that this study will aid coconut nira water entrepreneurs in Malaysia in a bid to enhance the development of the national coconut industry development in line with the current and future demands.

REFERENCES

[1] Ahmad Rabiul Zulkifli (2019) Permintaan berganda air nira kelapa. Harian Metro, Isnin, 6 Mei 2019. The New Straits Times Press (Malaysia) Bhd.

[2] Anim Hosnan (2012) Air nira. Available: http://animhosnan.blogspot. com/2012/01/air-nira.html

[3] Dharmakesuma (2012) Nira kelapa berkhasiat luarbiasa. Available: http://dharmakesuma.blogspot. com/2012/01/nira-kelapa-berkhasiat-luarbiasa.html

[4] Farizul Izwany (2019) Available: https://www.maskulin.com.my/kalau- anda-tahu-khasiat-air-nira-pasti-rasa-nak-minumnya-setiap-hari/

[5] Feldman, E. B. (1970). Becoming human through art: Aesthetic experience in the school. Englewood Cliffs, NJ: Prentice Hall.

[6] Marzuki Ibrahim (2013) Reka Bentuk Produk. Dewan Bahasa dan Pustaka, Kuala Lumpur, Malaysia.

[7] Noorazura Abdul Rahman (2020) Rezeki air nira, air kelapa. Harian Metro, Isnin, 6 Jan. 2020. The New Straits Times Press (Malaysia) Bhd.

[8] Omar Osman dan Nur Syazwana Mansor (2015) Usahawan nira dibantu. Harian Metro, Isnin, Selasa, 10 Mac 2015. The New Straits Times Press (Malaysia) Bhd.

[9] Mohamad Hussin (2018) Memulihkan industri kelapa. Harian Metro, Jumaat, 21 Sept. 2018. The New Straits Times Press (Malaysia) Bhd.

[10] YSuhaimi (2018) Kelapa : analisa industri. Available: http://myagri. com.my/2018/03/analisa-industri-kelapa/

[11] R. Sudha, V. Niral, K. B. Hebbarand K. Samsudeen (2019) Coconut inflorescence sap. Current Science, Vol. 116, No. 11.

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