

Recyclability Oriented Packaging Solutions for Sri Lankan Export Market: Design Development

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Abstract - Recyclability oriented packaging solutions (ROPS) are designed to be compatible with established recycling systems and facilitate the users to organise their waste management systems. It assists the global need of achieving a sustainable economy and reduction of environmental damage. So, when exporting products to EU countries, current legislation requires that the product packaging be designed in a way facilitating its recycling systems. Sri Lanka is one of the major exporters of spices to the western continent. So, incorporating ROPS into spice products packaging is equally important as the product quality. When considering the amount of research done towards the design development of ROPS for export products in the western continent, Asian countries like Sri Lanka are still at the basic level. To fill this gap, this research was conducted as a packaging design development project for Sri Lankan black pepper products exported by Sri Lankan Small and Medium Entrepreneurs. Considering 'recyclability' as a key factor, design development methodology was structured into three phases. First phase includes identifying potential target groups within EU regions. Second phase adapts the potential user group, product range for design development. Third phase was to test the final design and analyse the final design concept. As further research, the developed concept of packaging structure can be applied and tested considering different materials, product ranges, and it's possible to develop supportive machinery for manufacturing purposes.

Keywords: Recyclability oriented packaging solutions (ROPS), ceylon black pepper, Sri Lankan European export market-Germany, paper based packaging

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I. Introduction

The physical function of food packaging is to protect the product. The packaging must protect the product during transportation, storage and consumption and satisfy the consumer. In addition, food packaging should be such that consumers can easily access it and also extend the life of products as much as possible (Majidian et al., n.d.). However, product packaging is also one of the main contributors to municipal solid waste (EPA, 2019), with detrimental effects on the environment (Hall, 2017).

This suggests the need for more sustainable solutions, in the sense of packaging production and development, whereby the needs of the present generation will not compromise the ability of future generations to meet their own needs and with new packages developed consistently with the goals of sustainable development, from cradle to grave (Martinho et al., 2015) At present, the governments of many developed and developing countries are taking actions towards making citizens recycling behaviour compatible with existing recycling processes. So, they have regulated stricter recycling regulations and targets. Setting up strategies for a sound management of plastic packaging waste (PPW) is becoming increasingly crucial at many levels of the value chain in Europe. After the very first implementation of an extended producer responsibility scheme in Germany in 1991, many EU Countries followed. Germany set a material recycling target of 36% in 2017, increased by the “Packaging law—VerpackG” to 63% in 2022. (Picuno et al., n.d.) This has created a need to produce recyclability-oriented product packaging, especially when products are exported to the European market.

Sustainable packages have been defined as packages evoking via their structure or graphical elements eco-friendliness to customers, as for example through the usage of biodegradable materials, or eco-friendly logos (Magnier and Crie, 2015) In this case, sustainable packaging are expected to be designed in recyclability-oriented structures with biodegradable materials such as paper-based materials, and incorporate semiotically expressive branding colours, typography, logos, and illustrations.

Many Sri Lankan Small and Medium Scale Entrepreneurs use small craft boxes to export few bottled products as value packs. The craft boxes are environmentally friendly, but it doesn't ensure the compatibility with bottles safety, recycling system nor branding aspects of the SMEs.

Considering the above factor, the research objective was found to develop a recyclability-oriented packaging solution for bottled Ceylon Black pepper products to ensure its bottle safety and tackle branding aspects when they are exported to the European market. So, the goal is to create a branded dismantling packaging solution which tackles the European recycling system as well as product safety.

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II. The need and relevance of the study

The use of ROPS has become an essential aspect of the packaging industry in achieving sustainable development goals. It helps to reduce the environmental impact of packaging waste and contributes to the creation of a circular economy. The development of ROPS in Asian countries like Sri Lanka is still in its early stages, and there is a need for research to investigate the impact of incorporating ROPS in packaging solutions for export products to make them marketable. So, this study will provide insights into the potential benefits of incorporating ROPS in export products packaging.

III. Methodology

The methodology of the study is constructed into three phases.

A. *Identifying potential target group within EU regions*

In the first phase, a thorough market research was conducted to identify a potential market and user group. Analysing available data collected through literature review, peer discussions, social media interactions, YouTube Vlogs, German organic supermarkets were chosen as the most potential market to place the Sri Lankan black pepper products. Talking about Germany, they're the advocates of recyclability supportive packaging solutions as the households have recycled as a matter of course for years and introduced recyclability schemes and Packaging regulations. After identifying the market segment, user research was conducted within the selected market segment. Since this is a remote study, the same methods as the market research were used to identify a potential consumer group who shows potential to consume newly conceptualised products and packaging. Through that, German female consumers aged between 18 to 30 were identified as the user group who focus more on organic aspects of the products when they are at the supermarkets and consider environmental impact when they are shopping as well as volunteer to pay more for packaging that is more environmentally friendly. User persona board was created based on these behavioural variables as we move into the next phase.

B. *Adapt the potential user group, product range for design development*

In the second step, findings of the first step were adopted for the design development. The design development phase includes two sub phases.

- a. Developing a recyclability oriented (ROPS) structure incorporating design for disassembly
- b. Creating surface graphics considering users perception on recyclability

First sub phase was to develop a ROPS based packaging structure. The new structure was developed after examining the problems of the existing packaging solution, new opportunities in the existing recycling system and limitations. Before coming to the final design solution, several experimental design solutions were tested with the actual bottled product. 250gsm craft boards were chosen as the material for the entire structure of the final design, considering its tensile strength and organic vibe to ensure the product safety, recyclability aspects and consumer trust.

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Two Ceylon black pepper bottles (100mg for each) had to pack in one container. So, two separate bottle holders were developed to hold the bottles safely. To cushion the bottle structure outer packaging was developed. It was limited to five pieces which can cushion the bottles well.

Second sub phase was to create surface graphics for the outer packaging and the bottle labels. They were developed considering the target user perception on the topic of recyclability. So, graphical elements such as colours, typography, illustrations, symbols, and the information included on the surface was chosen according to the user's interaction with the topic. Colour scheme included three main colours. Two typefaces were selected for titles and body texts to keep the visual hierarchy as well as to match with the 'Eco' concept. Furthermore, line illustrations were included on the surface to increase the emotional appeal of the product to its target consumers. By the end of this step, a new design was developed to recognize it as a clear improvement than the previous design.

C. Test the final design and analyse the final design concept

The final design solution was exhibited at Profood-Propack exhibition 2022 and Annual design code at University of Moratuwa where it was exposed to the visitors. Here, their interaction with the new packaging solution was observed for the further learning to implement in future developments, and examined the success of the overall concept.

IV. Results and Discussion

To develop a new packaging structure, first primary forms such as cubes should be studied and experimented by different manipulation techniques. The 'dismantling' technique is such an idea born through continuous prototyping and idea generation. (Figure 1) This was focused on minimising the use of adhesives as much as possible in the new packaging structure. And 250gsm craft boards were used since the initial prototyping steps.

Figure 1
The first dismantling cuboid prototype



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Adopting this idea, the structure for outer packaging was developed. Then developments were focused on reducing the cutting lines as much as possible while keeping the 'dismantling' nature of the initial idea. Experimenting prototypes were developed while considering actual product size of the two bottles and internal bottle holders. From those ideas, the prototype shown in Figure 2 was selected as the best solution as it reduces using adhesives and cutting lines which makes it cost effective and the manufacturing process much easier.

Figure 2
The first dismantling box prototype



As the next step, finalised prototypes were taken to the mass manufacturing process to test the designs' feasibility with the production process. The design (Figure 2) was further developed through tests done with its opening mechanism. White dummy prototypes were manufactured as the initial step, continuously testing the packaging structure. To cut the white dummies, a Kongsberg cutting machine was used. And the cutting diagrams (Figure 3) were created by using Adobe illustrator software and exported editable pdf files to make them compatible with Kongsberg machine process. zThe final machine cut white dummy is shown in Figure 4.

Figure 3
The final cutting diagram

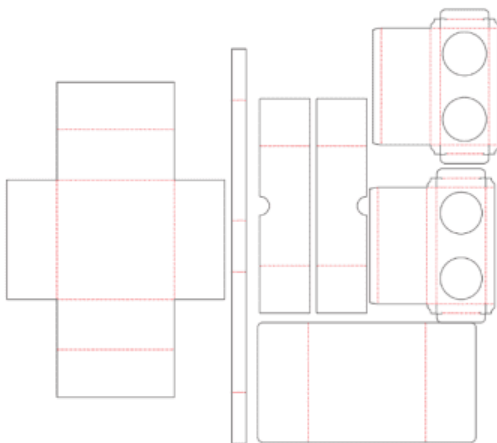


Figure 4
The final white dummy of full pack



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Prototypes shown in Figure 4 suggested a thinner board material than 300gsm and confirmed 250gsm craft board material as a feasible choice for the final structure.

The internal holders were developed prior, before finalising the final outer packaging structure. Like the structure of outer packaging, these internal holders were developed focusing on two main goals. One is to minimise the use of adhesives and other is to reduce the cutting lines. Below figures show the final bottle holders with the product.

Figure 5
The final bottle holders with product labelling



Then in the surface graphic development phase, In the beginning, four colours were chosen with a brown shade (#663300) but filtered into three colours. Brown shade was omitted because it doesn't give much contrast when applied on craft material. So, the following three colours (Figure 6) were finalised based on their appearance on the craft surface and target consumer perception on topics like recyclability, eco-friendly and black pepper products. To specify the decision more, grass green (#99CC00) was chosen to communicate the recyclability, and eco friendliness. Greyish black (#333333) was chosen to communicate the black pepper products stored in the packaging. Yellow colour (#FFCC00) was chosen as it was the client requirement.

Figure 6
Chosen colour palette



'Butler extra bold' typeface was selected for title texts and 'Grenale regular' typeface was selected for body texts. New logo was created. Following figures show the logo options created in the process.

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Figure 7
Few logo options created using colour and text styles



The finalised logo (Figure 8) has been given prominence to the yellow colour (#FFCC00), and greyish black (#333333). It was designed as a circular composition to easily apply on any branding material.

Figure 8
Finalised logo



Finalised bottle labels are shown in figure 9. Biodegradable vinyl sticker material was suggested through the study.

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Figure 9
Finalised graphics for the bottle labelling



Minimal illustrations were included on the surface as it enhances the value of the craft material in terms of communicating the 'recyclability' aspects of the design to its target consumer group who adores those values. As for the information for the consumers,

- Brand name, new logo ('Cholie Ceylonika' products)
- Sub-brand name (The Eco-pack)
- Product variations (Crunched and powdered black pepper)
- Brief explanation on the product
- Manufacturer details
- Storing instructions
- 'Grown in Sri Lanka' tagline.
- Nutrition table
- Health benefits
- Specified key words like '100% organic, Rich in piperine, 2 in 1 and no artificial ingredients'.
- Symbols – Recyclable, Food Grade, Dispose, Keep dry.
- Certifications – EU organic certification, Ceylon spice symbol, Green Dot

Were suggested to include on the outer packaging.

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Figure 10
Finalised design after manufacture



Fully completed Recyclability-oriented packaging solution (ROPS) is shown in the figure above. (Figure 10) However expected quality couldn't be gained through it due to the manufacturing limitations stated below.

- Final design was proposed to print in offset printing as it gives a quality output on craft paper, cost effective for larger volume prints, and produces consistent and repeatable results. However, this was printed as a sample, so digital printing techniques were used for the moment.
- Printing effects such as coating techniques were not used to keep the 'eco-friendly' concept and 'recyclability' goals. Instead, embossing, and debossing techniques were used to highlight the important details such as the logo and titles.

Below figures show the expected outcome by overcoming the previous limitation, had in the manufacturing process.

Figure 11
3D mockup of the finalised design with finalised surface graphics



Conclusion

From the study, it can be concluded that the recyclability-oriented packaging solutions can ease the process of existing recycling systems, incorporating different techniques. And the ROPS approach increases the product value in the European market since it's a part of the target consumer's lifestyle. And furthermore, 'dismantling' technique can be experimented further with different materials, products, opening and closing methods, concepts, and approaches. Also, the 'unboxing experience' it gives through disassembly, increases the consumer attraction to the product as it helps to smooth the recycling system.

This research only focuses on introducing one concept of dismantling product packaging to the German female consumers; however, it can be applied within any EU region which has interest on 'recyclability', 'Eco' concepts and 'Sustainable' models. There are different ways to explore based on this initial idea, and supportive machinery should be developed to get a smoother manufacturing process. Since this is the current global need, Sri Lankan export product should incorporate these kinds of techniques along with 'Eco' concepts when they are exporting products especially to the European market.

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