KnE Social Sciences

The Bandung Creative Movement 2023 – Enhancing Collaboration In Arts, Design And Craft For Sustainable Creative Industries: Technology and Art

KnE Publishing

Research Article

Exploration of Raw Eggs' Packaging in Corrugated Paper Material

Sheila Andita Putri*, Tanti Indah Pratiwi, and Andini

Product Design, School of Creative Industries, Telkom University, Bandung, Indonesia

Abstract.

Eggs are a source of animal protein which is the choice of Indonesian people. Nutritious, easy to process, and the price is much cheaper than other sources of animal protein, making eggs a commodity that is always sought after and needed. Compared to the type of eggs from other poultry, the types of eggs commonly consumed by the public are chicken eggs. The distribution of raw chicken egg products starts from breeders, distributors, to retailers. This distribution chain triggers possible damage to the eggs. Common damage is cracked eggs broken. This damage will certainly affect the profits of those who offer this egg product. These explorations aim to study the basic packaging structure to ensure the safety of the eggs packed. The exploration results and concepts can be applied in designing egg packaging or any other fragile items that are packaged in corrugated paper-based packaging.

Keywords: packaging, egg packaging, corrugated paper packaging

Corresponding Author: Sheila Andita Putri; email: chesheila@telkomuniversity.ac.id

Published: 10 January 2025

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the BCM 2023: Technology and Art Conference Committee.

1. Introduction

Food damage, including eggs, can be grouped into microbiological, physical, mechanical, biological and chemical damage [1]. Microbiological damage is triggered by microbial activity which allows the decay process to occur. Physical damage is damage that can be triggered by environmental conditions, such as humidity or sunlight. Mechanical damage is damage caused by pressure or friction factors. Other damage that may occur is biological damage caused by respiration and metabolic reactions of food ingredients. Damage may also occur due to chemical reactions such as oxidation reactions, hydrolysis, enzymatic reactions.

Packaging is a container to protect an item in order to keep it safe, intact, and also attract potential

Customers [2]. To prevent damage, especially mechanical damage, eggs are generally packed in stackable trays specifically for eggs. Usually, 1 tray can contain 20-40 eggs. Apart from being packaged in this way, eggs are also packaged in individual packages containing 10-12 eggs. The type of individual packaging used for egg packaging is generally made from mica plastic and corrugated cardboard. Corrugated cardboard is also known by various terms such as cardboard or corrugated paper. The use of corrugated paper material for egg packaging needs further exploration to ensure packaged egg products are safe from mechanical damage.

2. Research Methods

The research to be conducted is qualitative research. Qualitative research is methods for exploring and understanding the meanings that individuals or groups of people ascribe to social or humanitarian issues. This process requires important efforts, such as asking questions, collecting specific data from participants, analyzing data inductively and interpreting the meaning of the data obtained. The results of this study are usually flexible [3] (Creswell, 2010: 5).

The research process begins with collecting data on chicken egg packaging on the market. The data is then analyzed and supported by literature studies, seen from the material and packaging structure aspects. The results of the analysis in the form of design requirements are then used as the basis for packaging design. Alternative designs are then supported by material exploration and packaging prototypes are made. The results of the design and exploration are then used as packaging recommendations.

2.1. Methods of Data Collecting

Data collecting mainly sourced from literature studies, interviews, and observations about raw chicken egg packaging. The data collecting aim to find the information about. Existing egg packaging, Storage method, The structure of the packaging, partitions and locks used in raw chicken egg packaging made from corrugated paper.

2.2. Methods of Analysis

The Data collected used to concepting the packaging, build the prototype, and proceed to testing.

3. Result and Discussion

Corrugated paper has a variety of thickness variations that affect its ability to form a packaging structure while holding loads. The first experiment used corrugated single wall with a thickness of 2mm. This type of corrugated shape is easy to manipulate, be it bent, cut with a simple cutting tool, or rolled. The results of this first experiment resulted in a box packaging that had a good shape, but was not strong enough to accommodate 2 eggs. When used to pack eggs, the part of the packaging that functions to hold the eggs in position is damaged. Structural damage that appears, among others, is torn, broken, and warped. This damage causes the position of the eggs in the package to change position so that the safety of the eggs is not guaranteed. This is an indication that the material used is not thick enough so that it is not able to hold the weight of the egg.

In the second experiment, the corrugated single wall type used was increased to 3mm in thickness. the use of thicker corrugated is expected to increase the mechanical strength of the material to withstand the weight of the eggs on the packaging. In addition, corrugated with a thickness of 3mm is quite commonly used for egg packaging.

The principle of designing the structure of the egg packaging that will be made is to be able to protect the eggs from damage, whether broken or cracked. Potential damage that may arise can be caused by:

1. Factors from inside the packaging (Collision with other eggs).

2. Factors from outside the packaging (Collision with packaging, falling, or coming out of the packaging).

To avoid damage factors that can occur, there are several points that must be considered when designing the structure of corrugated egg packaging. The first point is that the position of the eggs must be stable, not easily change position, and have sufficient distance from other eggs to minimize the possibility of collisions in the packaging. This stable position is related to the structure of the packaging holder or the part where the eggs will rest in the package. The packaging stand that is made must be able to hold the position of the eggs, while at the same time adjusting to the size of the circumference of the eggs which tend to vary. This is because even though in practice eggs are sold based on their size grade, in reality there are almost no eggs that are identical in size.

Based on the experimental results, there are several variations of the shape of the egg stand, namely:

1. *Perfectly round,* the shape of the egg stand is in the form of a hole with a round shape and clamps the surface of the egg.

2. *Star incision*, the shape of the egg stand in the form of a circle which is divided into 4 or more parts. Tends to be more flexible in adjusting the size of the different egg circumferences.

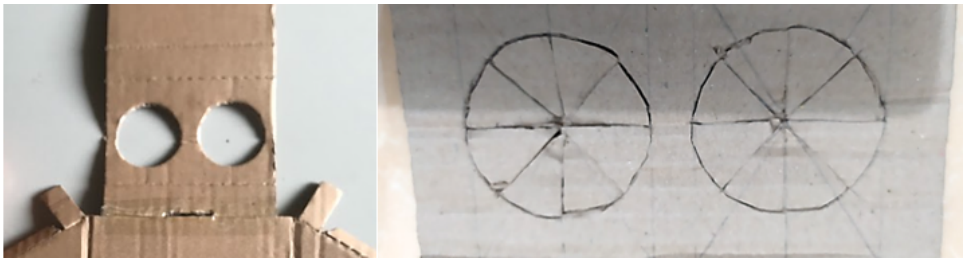

Figure 1: explores variations of the egg stand (Doc. Andini 2022).

Each variation of the egg stand has different characteristics in keeping the egg in position. For round shape egg stands, it cannot be used alone considering that the diameter of the hole often does not accommodate differences in the size of the different egg diameters. If the diameter of the hole is too small, the egg may roll and hit the egg next to it. If the hole is too large, the egg may slip out of the holder and touch the outer surface of the package. Of course, this has the potential to damage the egg shell if the package experiences shocks or falls. Based on the experimental results, this perfectly round holder can be used to pack eggs if the holder is made double (2 layers). This double holder holds the top and bottom of the egg for a more stable position. In double-cradles, there is sufficient clearance between the trays and the top/bottom of the eggs.

The egg stand with a star shape allows it to hold the position of eggs in packages of different diameters. Even so, this type of star incision holder needs to be made multiple (2 layers) to ensure the egg's position remains stable. This type of double incision stand is very possible to be combined with perfectly round stands in the same package.

The second point that must be considered when designing the structure of the egg packaging is that the surface of the egg does not come into direct contact with the outside of the package. The packaging system to be used must have sufficient space to absorb external impacts or vibrations. The ideal distance is where the packaging surface does not touch the egg surface directly. To prevent collisions between eggs in the package, it is necessary to have a partition system or separator compartment that allows the eggs to be in a stable position without hitting other eggs [4].This aims to avoid damage due to a dented packaging surface which damages the surface of the

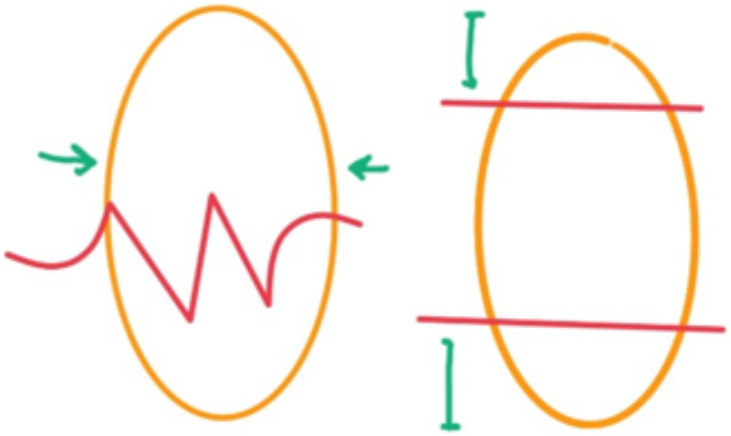

Figure 2: Illustration of a star incision egg stand on the side view of the packaging (left) single mount, (right) double mount (Doc. Putri 2022).

egg when a collision occurs. Therefore, the position of the eggs in the package must be hanging, in the sense that the eggs have a distance from the outside of the package. The position of this egg must be supported by an egg stand to minimize movement that might occur when the egg pack is subjected to pressure due to shock or impact which is symbolized in green.

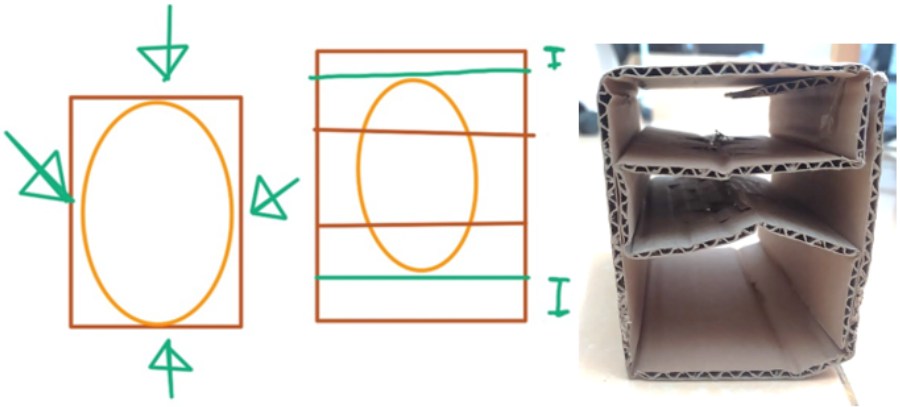

Figure 3: illustrates the position of the eggs in the packaging, (left) the eggs without the distance from the packaging, (right) the position of the eggs with the distance (Doc. Andini 2022).

Apart from the position of the eggs in the package, another thing that needs to be considered is the overall structure of the package. In general, packaging in the form of cubes or blocks is more widely used because of the efficient use of space in the package, efficiency in the use of materials, and ease of storage in large quantities. Packaging with this shape allows it to be stacked and waste material tends to be less

than packaging with a curved shape. Viewed from the user's point of view, this form also makes it easier to open and close the packaging.

In this exploration of egg packaging, the packaging must be able to maintain its structure to avoid changing the position of the object packaged in it. This means that the packaging structure must be sturdy and not easily deformed even when subjected to pressure, both during the handling and impact processes. For this reason, all sides of the packaging must be connected with locks to maintain the packaging structure.

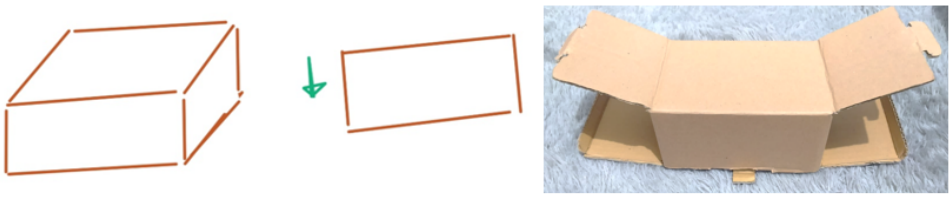

Figure 4: The illustration of the shape change in the box packaging structure with closed sides (Doc. Putri 2022).

In comparison, packages whose sides are open/not interlocked can change shape when subjected to pressure due to pushing, shock or impact (symbolized in green). This change in shape can affect the position of the eggs in it, thus allowing damage to occur.

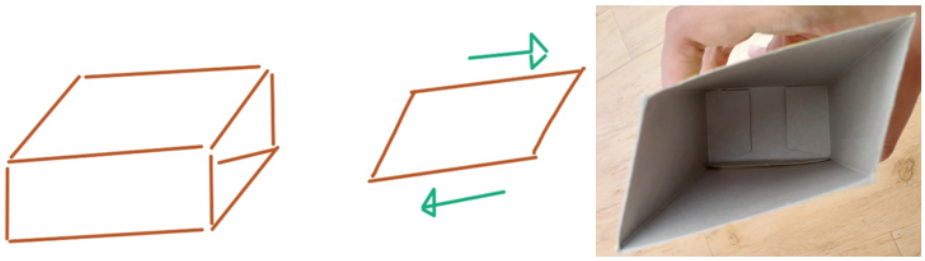

Figure 5: illustrates the deformation of the box packaging structure with open sides (Doc. Putri 2022).

Based on the concept and results of the exploration of the seat and structure that have been described, the results of the exploration of the packaging made are as follows:

In the packaging structure above, it can be seen that the egg stand used is a star incision holder which consists of 2 layers (multiple). This is done to ensure the position of the egg remains stable. The shape of the box packaging adopts a closed box packaging structure in which all the parts of the box are connected by locks. This is to be done to minimize the possibility of the holder changing position when the packaging is subjected to pressure.

Figure 6: The prototype packaging (Doc. T. I Pratiwi 2022).

Packaging testing is carried out by dropping the package from a height (drop-test). The package is filled with 2 raw chicken eggs, then dropped from a height of 1.5 – 2 meters. This test is carried out to simulate extreme conditions where the packaging is subjected to pressure and impact.

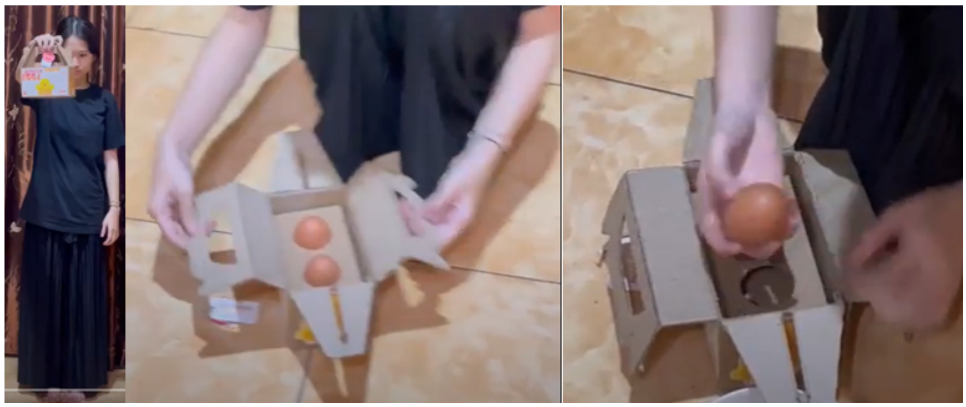

Figure 7: The prototype testing (Doc. T. I Pratiwi 2022).

The test was carried out 2 times. After being dropped from a height of 1.5 meters, both the packaging and the packaged eggs were in a safe condition. Furthermore, the same package is dropped again from a height of 2 meters. The result is a slightly dented package but the eggs are in a safe condition, not cracked or broken.

4. Conclusion

The conclusions from this exploratory process are as follows:

1. Packaging that is made is able to protect the product from and pressure.

2. For fragile products such as eggs, it is recommended to use a double holder system (2 layers) to ensure the position of the packaged product remains stable.

3. The egg stand must be able to provide a safe distance between the egg and the outer wall of the package to prevent damage from impact.

4. The recommended holder shape is a star incision to facilitate the size of different egg diameters. It is possible to combine perfectly round stands with star incisions.

5. Each side of the box-shaped packaging must be connected with a lock to avoid deformation due to pressure.

References

[1] Rahmawati F. Kerusakan Bahan Pangan. Yogyakarta: Universitas Negeri Yogyakarta; 2013.

[2] Putri SA, Pawestri AS, Hutami AN. The packaging structure exploration of ready-to-eat kebab products for street vendors (Case Study: Royal Kebab, Kebab Franchise). In Dynamics of Industrial Revolution 4.0: Digital technology transformation and cultural evolution (pp. 214-218). Routledge. 2021.

[3] Creswell JW. Research Design: Pendekatan Kualitatif, Kuantitatif, dan Mixed. (diterjemahkan oleh: Achmad Fawaid). Yogyakarta: Pustaka Pelajar; 2010.

[4] Putri.SA, Ramdhianty A, Syahid A. Pengembangan Visualisasi Tanda Pengenal Merek Pada Produk IKM Sentra Telur Asin Derwati. Charity : Jurnal Pengabdian Masyarakat, [S.L.], V. 3, N. 2. ISSN 2655-5336. Available At: <//Journals.Telkomuniversity.Ac.Id/Charity/Article/View/2350>. 2020. [Accessed: 14 Nov 2022]