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"Design and development of innovative packaging for agricultural products"

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Abstract

The main goal of this study is to design new and innovative packaging for agricultural products with the use of eco-friendly raw materials, processes and practises. The products considered in this study were local Greek produce like olive oil, tsipouro, raki, fruits and vegetables. These products are currently packaged in a very conventional way and it is generally recognised that the current packaging solutions do not reflect the quality of the produce or the ecological trends worldwide. The whole study was based on the use of Computer Aided Design programs and other digital technology. Glass and wood was used for the packaging of the fluid produce (olive oil, tsipouro and raki) and the raw material for the packaging solutions for the fruits and vegetables (crates) was olive tree pruning and wood wastes with the use of ecological glues. Other ecological aspects that were considered and utilised in the current proposal/study were 1. the re-use of the packaging. 2. the use of less raw material than current practises, 3. Ease of assembly and disassembly (separation) of materials.

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1. Introduction

Tons of packaging ends up in landfills every day in the world and most of it is harmful to the environment. The scope of this study was to research, design and propose package designs that reduce the toxicity of packaging by using eco-friendly materials and also encourage the re-use of the packaging by the end user, therefore reducing the amount of it being thrown away. Most of this research, design and prototyping was conducted through digital media and software.

2. Methods

2.1. Laboratory Research Methodology – packaging of fruits and vegetables

The basic objective of the experiments conducted was the research into new raw materials to be used towards the formation of flat stock material that will be used to make the packaging. The raw materials considered were tree leafs and branches - removed under standard agricultural procedures – from the Olive, Vine and various fruit trees, as well as wood and wood chips that are considered as waste after normal woodworking operations. The raw materials from the trees were left to dry under controlled conditions (i.e. the leafs are pressed flat) for one month and then most of the stock is crushed or cut into small particles and mixed with the wood chip stock and glued via an ecological glue [1]. Then the mix was placed and pressed in a flat mold with heat in order to produce a flat stock. The dimensions of the sample plates produced were 200 X 200 X 5 mm.

2.2. Design Study

Extensive research was conducted prior to the design of the new packaging with the help of digital technology. A questionnaire was distributed to two regional clusters of farmers in order to define their needs. Research into current trends was also conducted and the results of the research as a whole concluded into a design brief that was based on four pillars:

- Rarely the packaging material is the same or connected with the content of the packaging,
- Wood as a raw material is increasingly used in packaging,
- Wood and agricultural waste are ecological materials, and consumers increasingly are aware of this
- The design for re-use of the packaging of any product is extremely rare, but could make a difference with consumer choice if it was offered.

The methodology of the design process was as follows: Through brainstorming sessions many ideas were produced that were then sketched out and discussed again and this led to even more ideas being produced. The ideas were then assessed and the best of them were developed further through the use of digital media and CAD software like AutoCad, Inventor, Ashlar - Cobalt and 3d Studio Max. Some prototypes were produced through digital 3D printing methods and others through conventional prototyping techniques. Finally, video animations and drawings were produced in order to fully specify the solutions offered and illustrate the usability and other design criteria [2].

3. Results and Discussion

Flat stock material was produced in the laboratory in order to determine if such flat stock was appropriate to use for the construction of fruit and vegetable packaging [3]. The results of the quality testing were encouraging and

the design team decided that if this technology (in flat or moulded form) was to be used commercially it would be possible to produce packaging from such stock, see Fig.1.



Fig. 1. Sample plate from wood chips and Olive tree leaves.

3.1. Packaging for fruits and vegetables

The technology described above (flat or moulded stock from various wood or tree waste) was used as the key element to design three types of packaging for fruits and vegetables. The **first crate design (A)** uses such flat stock and a biodegradable transparent film that is glued by heat on both its surfaces. The film keeps the elements together at all times [4]. The flat plate is pre-scored and transported flat to the packaging station. Each plate is folded, fairly easily and produces the desired three dimensional form of the final packaging, see Fig.2.

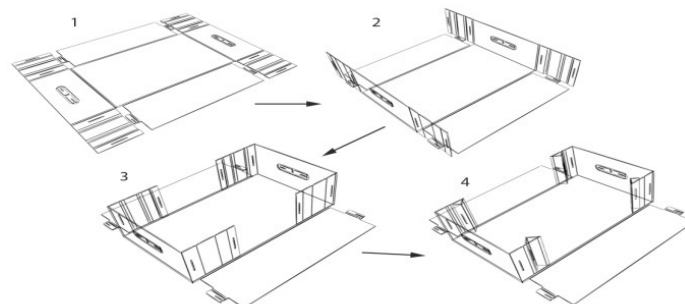


Fig. 2. Crate Design A, is folding the flat plate.

The second crate design (B) is a moulded crate design for fruits, see Fig.3, that allows for tight stacking of the packaging when it is not in use and by rotating each plate by 180° degrees the packaging can hold fruits and keep them in a safe distance so the fruits do not touch each other.

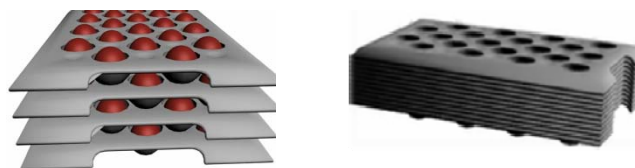


Fig. 3. Each crate (B) rotates 180 deg. In order to safely hold fruits.

The third crate design (C) is composed of five appropriately cut plates that can be connected by the very common method of Tenon and Groove and the use of elastic bands also made from biodegradable plastic (like PLA). The pieces are transported flat to the packaging area and assembled quickly as described in, see Fig. 4. The three proposals described use the same eco-friendly stock described (mix of wood and tree waste with biodegradable plastic film or elastic band) and will all biodegrade safely after use. Further research could be conducted into to the technology of commercially producing the stock material.

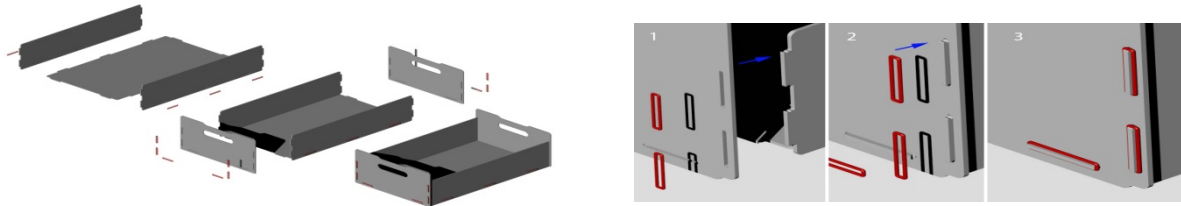


Fig. 4. Assembling the Crate design C

3.2. Packaging for Tsipouro/Raki and Olive Oil

The design team also experimented and produced three final designs for liquid products (Olive Oil, Raki, and Tsipouro) and their special Gift Box packaging that is usually available at Airports and other points of sale worldwide. The first proposal (D) is a glass bottle with a cup that is made from pressed wood stock with ecological glues. The design of the bottle reflects the fact that both these liquids should be consumed very cold and hence the polyhedral geometry reminds the consumer of the ice crystal formations, see Fig.5. The cup is molded from wood or tree waste material as described earlier (preferably from the same plants that make the liquid packaged) [5]. The bottle, after the liquid product is consumed) can be re-used as a water bottle in the fridge of the consumer.

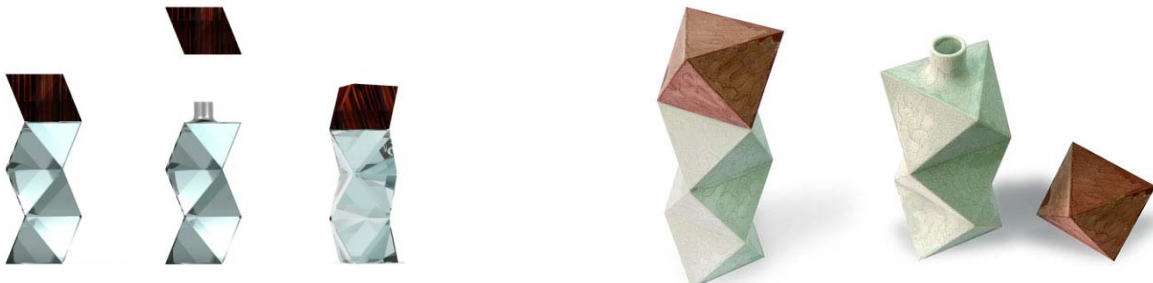


Fig.5 Rendering of the proposal (Ashlar Cobalt) and full scale model produced at the 3d printer

The second design proposal (E) is a Gift Box for a standard glass bottle of Olive oil, see Fig. 6, made from wood and tree particles as described earlier. The Gift Box can be re-used as a storage box for small items. The third design proposal (F) is also a Gift Box for a standard glass bottle of Olive oil, see Fig.7 and 8, made from wood and tree particles as described earlier. The Gift Box can be also re-used as a storage box for small items. The shape of the box is from the shape of the Olive Tree leaf.



Fig. 6, Rendering of the design proposal E (3D studio Max)

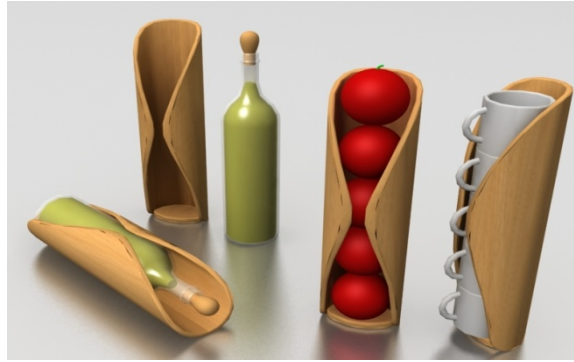


Fig. 7 Design Proposal F rendering (3D studio Max)



Fig.8 Design Proposal F rendering (Ashlar Cobalt)

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