



STUDY OF THE APPLICATION OF BRAZILIAN'S ARTISANAL BRAIDING IN PACKAGING DESIGN FOR FRESH FOOD.

Marília Colozio Favaro¹, Adriana Yumi Sato Duarte¹, Franco Giuseppe Dedini¹

¹UNICAMP - Faculdade de Engenharia Mecânica, Rua Mendeleiev, 200 - Cidade Universitária "Zeferino Vaz"
Barão Geraldo - Campinas – SP- Caixa Postal 6122 CEP: 13.083-970

Abstract. *This research aims to indicate the use of Brazilian handicraft techniques, specifically the artisanal braiding, for the development of packaging for food products, specifically grocers. Therefore, the research is based on the study of the interface between the braided, packaging design and methodology and design tools. The study of the construction of braided is based on formal and geometric features, without, however, neglecting its history and its economic, social, cultural, and environmental importance. Another important point to achieve the proposition of this research is the analysis of the main parameters for the development of packaging through literature review. Finally, the design methodology guides this study due to the complex system of variables, since it requires a multidisciplinary view, and indicates the DFE (Design for Environment) as a tool for integration of environmental and organizational management. In conclusion, the reason of this research is to indicate the application of artisanal braiding on developing packaging design in order to allow at the same time the rescue of tradition, which is being lost throughout generations, and product innovation.*

Keywords: *Packaging Design, Artisanal Braiding, Methodology, Product Design, Design Tools.*

1. INTRODUCTION

The main function of packaging is to protect the product until the moment of its consumption, thus care should cover the whole route since the transportation from the farm until the consumer at the time of purchase and at home.

In Brazil, before European settlement, the Indians used the artisanal braiding for making baskets, mats and hampers with fiber of local vegetation for different purposes and in different sizes. This fact demonstrates that the manufacture of packaging was done in an artisanal way, and from the eighteenth century, the Industrial Revolution addresses a new concept to the market: mass production and the increase of product offering. Man, because of his ability to modify the environment to better meet your needs, create objects and instruments that are used until this day (PAPANNEK, 2000).

The mass production of objects for immediate consumption and the search for new materials generate perceptible and imperceptible impacts on the environment and society. For this reason, it is important to take into account the existing knowledge about handling, technical transformation of raw materials and dynamics of ecosystems, to allow the development of economic systems, social and cultural compatible with the current situation.

The package has as main functions to protect and transport, in order to avoid mechanical damage and group products in units appropriate for the market and handling (LUENGO et al, 2006). As for the secondary functions include: sales (which involves aesthetic considerations) economic visibility and identification (KOTLER, 1998).

The development of packaging can be termed as the act of travel a track established by the design methodology, meeting the peculiarities that packaging has in relation to other industrial products, should be worked as a whole, in other words, the context in which the product is inserted is a relevant factor for the development of the product (MESTRINER, 2002; CARVALHO, 2008).

Based on this background, this research aims to indicate the application of artisanal braiding on developing packaging design in order to allow at the same time the rescue of a Brazilian tradition, which is being lost throughout generations, and product innovation.

2. RESEARCH BACKGROUND

2.1 Packaging

The word packaging, derived from the verb *pack*, "act of storing (merchandise or objects) in packages, bales, pack, to protect them from risks or facilitate its transport" (Holland, 2004 apud NEGRÃO, 2008), it has as leading functions the protection and transport. As man became aware of their basic needs in feeding, storing and conserving the food for a longer time and with increasing distance between the sources of supply, it was not enough to reap more and hunt, it was necessary to store and transport. (TOGA, 1985, p.25).

Archaeological records dating to 2200 BC show that the primitives used "packaging" made from natural materials found at the time, such as leather, animal entrails, fruits, leaves and other vegetable fibers, to store their food. Technological developments were inserted continuously in human life, finding themselves new materials, new needs and a wide range of products which makes use, proportionally increasing the amount of product to be packed and a diversity of materials used in these wrappers (NEGRÃO et al, 2008).

In the twentieth century, due to the limited sophistication of industrial production, commerce was based on small establishments. Used at the time four basic types of packaging: wooden barrels, bags tow and papers (usually used for storing coffee beans), glass bottles and jars (sardines, meats, sweets and beverages) and cans (containing butter and oil). Divided into steps of transport, which contained large quantities subsequently were weighed in the amounts requested and taken in smaller bags (NEGRÃO et al, 2008).

At that time, the aesthetic and communicative aspect of the packaging was merely representative. Hereafter, was added commercial value reason of the scale of the product marketing and new packaging concepts, creating the system of self-promotion - method initially used by supermarkets as a new communication technique to persuade the consumer to buy a particular product, without the influence the seller.

At that moment, the packaging acquire new functions: besides of to protect and transport, start to inform, identify and promote products and brands. In some cases, it may be the way to present the product and thus promote sales, storage and transportation, or a means of satisfying the desires of the consumer of the product, and these points comes from marketing professionals, technicians and consumers (Muniz, 2008).

Therefore, its classic definition is to protect the product and keep it contains, ease of handling, storing and transporting and today from the twentieth century to promote and stimulate product sales that has the focus, area, product and purpose (JUNIOR, 2006).

According to Neto (2009) the packaging has the principle pack, package, bale. External protection and for presenting the market is used bags fabric, paper or plastic material sheets, among others.

In Brazil, the Ministry of Environment in DL 366-A97 says "any and all products made from materials of any kind used for the containment, protection, handling, handling, delivery and presentation of goods, both raw materials and processed goods, from the producer to the user or consumer, including all friends "disposable" used for the same purposes "(NEGRÃO et al, 2008).

Silva (2000) affirms that "creation process, its efficiency and performance [of the package] is checked in the success of the product which involves all the adversities of creation, being interpreted as a technical object, function and particular technological features. The design of a package requires technical knowledge and psychological, and experience and talent of their responsible".

For Mouro and Banzato (2006), "[...] is the set of arts, sciences and techniques used in the preparation of goods, with the goal of creating the best conditions for their transport, storage, distribution, sale and consumption or, alternatively, a way to ensure the delivery of a product in a reasonable condition at the lowest global cost. "Contextualizing in a complete form, objectively, they define the package as "element that protects what sells and sells what protects."

As definition of packaging, Gurgel (2007) presents the following viewpoint on the term:

[...] s are wrappers, receptacles or any form of removable packaging, or not, designed to cover, packaging, bottling, protect, maintain the products, or to facilitate their commercialization (GURGEL, 2007, p.1).

The Brazilian Packaging Association (ABRE) determines to be considered as packaging all the container or wrapper that stores product temporarily, separating or grouping units, with the primary function to protect in order to prolong their shelf life, enabling the distribution, identification and consumption.

Independently of the denotations used, it is a consensus employed in a complex world, consisting of various sectors that drive the world economy, plays a decisive role in the success of a product, as well as intervening in the habits, behaviors and habits of an entire society (MUNIZ 2008).

Over the years, packaging had an important contribution to the development of industry and the consumer society. Currently, it has become critical to the success of the product, because the consumer does not separate it from the content.

The market produces over seven thousand different items. Almost 70% of the products sold utilize packaging, this because most of the products are perishable and without the receivers, there would be no possibility of use a large part of goods.

In industrial capitalist society, production, use and distribution of packaging are a global business, estimated at billions of dollars, a value that will grow rapidly the next few years with the expansion of global trade. In Brazil, the packaging sector represents 1.5% of national GDP, exceeding the mark of 11 billion dollars in annual sales (MESTRINER, 2002).

There is prospection of a worldwide increase in the consumption of packaging, but in Brazil still lacking professional in this area. A study by IBRE (Brazilian Institute of Economics) in partnership with FGV (Getúlio Vargas Foundation) to ABRE, demonstrated that packaging recorded net sales of R\$ 46.1 billion in 2012, overcoming R\$ 44.7 billion generated in 2011, even with the downturn in production. It is estimated that in 2013, the sector is expected to grow in the year up to 2% and achieve net sales of R\$ 48 billion, compared to R\$ 46.1 billion in 2012.

Facing the competitive environment, the reducing waste global is shrouded the optimization of utilization of food and inputs demanded by society, becoming a business strategy with respect to the distribution, sale and packaging efficiency. Require expertise to be a good design that ensures the preservation of content, directly influencing the cost, technology, distribution, in the conquest of consumers and form of consumption of the products.

A production consists in the partnership between national and multinational industries packaging in global operations, able to cater to different markets, helping to harmonize the quality parameters, technologies, tendencies and functionality, along with a well-structured chain involving raw materials, manufacturers equipment for the manufacture of packaging and process bottling of products, supplies, accessories, transport and logistics companies, design agencies, companies of consumer goods, technical training and higher courses, testing laboratories, research and study and regulators.

For the manufacture of packaging, all these sectors should be together in a great harmony and precision of their activities aiming at the needs of consumers - their demands and expectations, and the specifications of retail - which is a major influence in the new standards consumption and communication technologies leveraged by accessibility.

It is necessary to take into account all the parameters that interact as the product, otherwise it may result in errors projects. The acquisition of packaging material, assembly, filling, distribution and customers are relevant information at first instance. Moreover, the physicochemical characteristics and its distribution should be important in the design of the package.

The type of transport, the level of vibration suffered in the displacement and the product handling, stacking height, humidity and storage time are parameters that must be taken into account in the design of packaging because they represent a cost savings while using fewer material as possible and the possibility of increasing the number of products transported only once, thereby restricting investment in transport and storage.

A package more resistant reduces the damage losses and improves stability for a stacking more secure. These measures have relevance to ecological aspects, minimizing wearing down the packaging after use. Information of product characteristics that make it more or less vulnerable to oxidation, dehydration, decomposition, sensitivity to light and ultraviolet rays, presenting low thermal stability and volatility, should be specified for storage in ideal condition because the packing should optimize the conservation and transport of the product.

2.1.1 Features of packaging designed for fresh food

In packaging design, information such as the stability of the product and the level of fragility or sensitivity are essential to define the protection that the packaging will supply, involving mechanical stability, chemical and electrical. As the type of product to be studied is extremely sensitive, where a mistake can be fatal, it is necessary follow up the entire chain of distribution, because it is common to find this kind of product stored in inappropriate places, subject to humidity high temperature, water, food stored together with incompatible chemicals products and storage on pallets and shelves with mold, as well as inadequacies in transportation.

Furthermore, the shape of the package should be designed to maximize the circulation of air inside and to provide adequate structural strength. Each type of agricultural product requires a suitable production process. The classification, packaging, handling and shipping of these directly influence the quality of the product and the misuse can lead to waste and bring harm to producers and consumers.

The CEAGESP (Company of Deposits and General Warehouses of the State of São Paulo), through the Center for Horticulture Quality, shows some proposals for the prevention of losses from production to consumption of fresh fruits and vegetables. The losses on valuation chain of fresh vegetables happen during the process of production of products at natural, in the bunkhouse of classification, in the central of supply, in the gondola and loss of consumer.

Also, they propose action for the prevention of losses along the chain of production, marketing and consumption, together with all their agents: creation of a commercial code for the marketing of perishable fresh products; funding for infrastructure improvement of harvesting, grading, packing, storage and transport; requirement of obedience to the law of food transport, training of those involved; parking payment for length of stay; improvement of transport infrastructure, receipt, storage and display; requirement of obedience to the law of labeling, packaging, protection; Campaign of Adoption of the Minimum Handling and investment of educational material about the fresh vegetables products for distribution in schools.

The great centers CEASAS (Central State-Owned of Supply) throughout Brazil are characterized as places where large losses occur. The data show that there is a loss of 35% of agricultural production in Brazil for lack of appropriate packaging, which represents about 22 million tons of food thrown away (NEGRÃO et al, 2008), which could serve as food for many starving families, demonstrating that, despite the growth in packaging industries over the years, the purpose of meeting the needs of products, producers and consumers is still distant.

The most important causes of post-harvest losses of fruits and vegetables are the handling and use of inadequate packaging and the consequential mechanical damage to the product (BALLOU, 2001), allowing contamination by diseases and inadequate for charge or discharge mechanized, problems which can be reduced with the use of appropriate packaging. According to IEA (2006) apud NEGRÃO (2008), these losses can be minimized by using

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suitable packing, palletizing charge, cooling, transportation and storage adequate, to provide a reduction in the percentage of loss and maintaining the quality of products.

The mechanical shock and vibration during transport and handling of products are the most responsible for the damages suffered. This includes manual or equipment movement such as treadmill, carts, forklifts, elevators, requiring appropriate packaging (CARVALHO, 2008).

In the market, there are non-returnable and returnable packaging, which are on average used 100 times, requiring 36 million packages a year to satisfy the demand. Containers used in the harvest, transportation and retail, in most cases, are made of wood with a rough surface, with no external measures for pallets and reused without sanitizing. Besides wood, the most common materials for packaging fruits and vegetables are cardboard, plastic, jute and nylon.

The wood packaging is traditionally used in the retail and wholesale markets for the packaging and transportation of products. The boxes 'K', 'M', 'torito' and crate (Fig. 1) are the main types of models in wood used for most fruits and vegetables. They have a rough surface (unworked wood) and are reusable; however, they aren't subjected to the cleaning and disinfection process, resulting in bacteria and fungi that cause disease and post-harvest losses. The crate model has wide cracks and causes many injuries to the product, do not protecting it to the incidence of wind and heat stroke, facilitating dehydration of the load (LUENGO et al, 2006).



Figure 1. Boxes of type “k” and wooden crates (LUENGO et al, 2006)

The cardboard boxes shown in Figure 2 are currently used on a smaller scale, although they provide lower costs due to material and manufacturing process simpler. As a characteristic, they have a smoother surface compared to wooden boxes, which minimizes the occurrence of mechanical damage to the product by abrasion during transport. They are supplied unassembled and enable the print of the brand with the identifications of the supplier; exhibit low moisture resistance and are disposable.



Figure 2. The cardboard boxes (LUENGO et al, 2006)

Plastic packaging for fruits and vegetables (Fig. 3) are gradually and slowly replacing those made from wood. They are reusable and can be washed and sanitized, to eliminate the contamination and the spread of disease problems that the agricultural products present. They allow ventilation of the products, even in air conditioned environments, increase cargo security attributes by design (modular, without edges and self-adjusting), but the high cost does not justifying its use with no return, because it needs specific tools (molds) with a high cost, which ends up increasing the price of the packaging.



Figure 3. The plastic boxes (LUENGO et al, 2006)

The nylon and jute bags are generally used for potato and onion, in capacities of 20 and 50 kg (Fig. 4). It is a package of low cost, but which does not provide adequate protection to the product and causes many injury to the vegetables.



Figure 4. The Jute bags are used for potatoes and nylon bags to pack onion, pumpkin and fruits. (LUENGO et al, 2006)

Another resources are the bags with open bottom, which assist in the transfer of the product to the final packaging, as well as baskets and other plastic containers used at harvest. For products with higher sensitivity, small packs are used with the exact amount for consumption by the end customer. It is always important that the surface of contact with the product is clean and smooth.

In addition, there is in the market accessories to improve storage conditions and product protection. They are: trays with dividers that allows the individual housing for each fruit, usually made of molded cellulose pulp and thermoformed plastic sheets; individual roles; gloves and plastic foam and partitions, and more (LUENGO et al, 2006).

2.2 Handicraft Production in Brazil

During the period of colonization of Brazil, the development of handicraft workshops started from the need of functional objects and as a consequence, the initiative became popular and multiplied the presence in both rural and urban communities (MARTINS, 1973).

The formal sector has begun since 1950, through a partnership between public and researchers. Following this initiative, several similar projects have been developed regionally, on a trial basis. However, the issue of handicraft production in Brazilian resided in financial, technological, commercial and managerial factors that, over time, prevented the permanent production.

The mobilization and the need to create an integrated planning for the revitalization of handicraft activities stimulated the First National Handicraft Meeting (I ENA) in 1975. Two years later, there was the creation of the National Handicraft Development Program (PNDA), considered a landmark of handicraft production in Brazil (SERAINÉ, 2009).

Then in 1995, SEBRAE (Support Service for Micro and Small Enterprises) created the Program SEBRAE Handicraft (PSA), active to this day. This program defines handicraft as "productive activity that results in products made manually or with the use of traditional means or rudimentary, with skill, dexterity, creativity and quality" (SEBRAE, 2004).

In a survey conducted during the year 2009, this sector, in Brazil, employed 8.5 million artisans, generating gross revenues of R\$ 52 billion per year. The data showed that the utilities are the main category of production (69%), followed by clothing (57%), assuming that each artisan produces more than one type of product. The average turnover

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of the last six months prior to the survey was R\$ 10,127.14. When comparing data from 2005 to 2010, is remarkable continued growth of the production of garments, and the production of utility articles is the most relevant category of general crafts (VOXPOPULI, 2010).

This research has shown that the labor is mostly female (73%), present mainly in the Southeast (78%), aged 31-50 years with high school education. Another research concerns the degree of association, since non-members tend to invest more and make more than the artisan associated with some entity (VOXPOPULI, 2010).

2.2.1 Artisanal Braiding in Brazil

The artisanal braiding has its origin on an indigenous tradition and uses flexible materials in the form of thread, foil and strip. The artisanal braiding is made mostly, but not exclusively, with natural materials collected from the local flora.

Built out of necessity or function that the product is intended, the artisanal braiding requires the union of knowledge of patterning and raw material used. This activity generates a wide range of products, such as baskets, term designating for a certain order of braids. The abundance and ease of access to raw materials coupled with the multiplicity of symbolic and utilitarian objects allowed the development of numerous products such as mats, baskets, furniture, and colanders (FUNARTE, 1986).

Ribeiro (1988), in his pioneering study on the topic, classifies the indigenous artisanal braiding in five generic groups: braiding for use and domestic comfort, braiding for hunting and fishing, braiding for processing cassava, braiding for individual use and braiding specific for sale, as shown in figure 5.

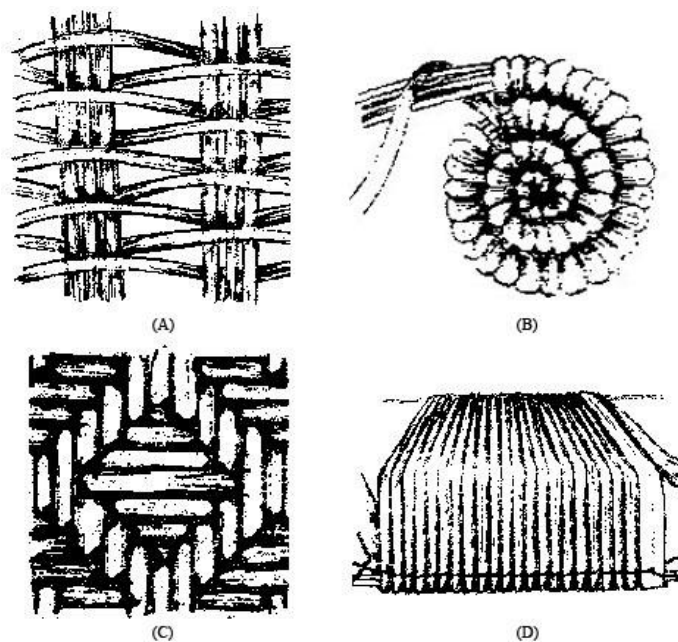


Figure 5. Arched (A), Frame (B), Twill (C) and Folding (D) Braiding (RIBEIRO, 1988)

The act of braid is to make the weft go under or over the warp, elements fundamental to the formation of the braiding. The weft means the threads positioned horizontally (figure 6A), while the warp is characterized by a group of tensioned threads in a vertical position (figure 6B). The final representation of the braiding is called frame in which all weft and warp are considered (RIBEIRO, 1984).

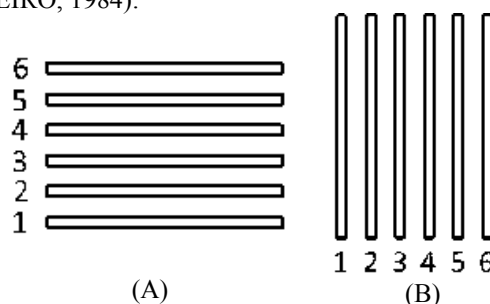


Figure 6. Weft (A) and Warp (B)

The variations are due to the motion of the interweaving of warp and weft together with the intrinsic characteristics of the material used, coupled to the memory and ethnic group technical producer. It is important to note that this activity requires specific knowledge management, technical transformation of raw materials and ecosystem dynamics, allowing the development of economic systems, social and cultural compatible with the environment in which it operates.

2.3 Design Methodology

Since the early days, from simple to complex mechanisms producing consumer goods and transportation systems, man has been designing and developing objects. Therefore, it is necessary to unite science and engineering, politics, psychology, economics, technology and manufacturing, design and art to underlie the construction, development and project definition (PAHL et al, 2007).

Design methodology has the principle of application and reproducibility in any problem. The beginning of the methodology starts with a problem expressed by human needs to form and formalize a knowledge base that assists the designer in finding the solution (BITENCOURT, 2001). Asimow (1968) opened the discussion on the topic, and was the basis for other authors to modify and adapt the methodology according to the requirements in effect in each period. His methodological model is divided into two main phases related to the project design, development and production activities and support services cycle phase production-consumption.

The strategies of eco-design and design tools should be incorporated at every stage of project development, as well as environmental impact assessments before proceeding to the next phase. These aspects should be incorporated into the design at an early stage.

There are few publications in packaging development, that can be describe by Griffin (1985), Paine (1996), Romano (1996), DeMaria (2000), Ten Klooster (2002), Bucci et al (2007), Negrao et al (2008) and Carvalho (2008). Bucci et al (2007) presents a model of pre-project to develop sustainable packaging project, keeping in view the needs and concurrency between Development Product and Development Packaging processes, as noted in figure 7. For the development of new projects, the model is primarily stocked with current information about technology, marketing research, information products and processes of environmental impact, materials, competitive intelligence, life cycle assessment of packaging in order to achieve environmental goals and established strategic.

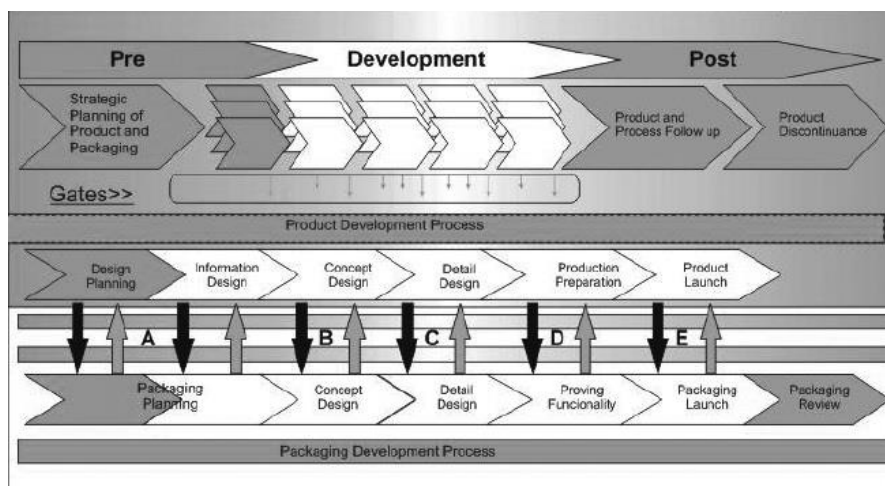


Figure 7. Sustainable Packaging Development Process (BUCCI et al, 2007).

This planning includes two macro phases, first integrating targeted product and packaging, listing information generated from different sources, with the two project areas - product and packaging. The second phase consists of informational integration of product design and planning package, which establishes a target specification of the system of product-packaging (BUCCI, 2007). The methodological tools are applied in an integrated manner in order to provide a better understanding of the system, product packaging, and this is related to the need of the consumer (RAPER, 1999).

2.3.1 Design for Environment (DFE) and Sustainability

In 1983, the United Nations (UN) established the World Commission on Environment and Development, and a report published in 1987 originated the concept of sustainable development. In this report, entitled "Our Common Future", meeting the needs of the present without compromising the ability of future generations to meet their needs also in effect between premise was to reverse the rampant consumption and production (BRUNDTLAND, 1987).

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Manzini and Vezzoli (2002) state that the project aims to design and develop solutions to consume less environmental resources and improve technical and social. Appears in this context the sustainable design, with concepts, guidelines and tools that guide economic strategies, social, environmental and projective.

According to Sachs (2008), sustainability should be analyzed under five dimensions: social, economic, ecological, cultural and space. In social, the goal is to build a society with greater equity, which leads to the economic aspect, suggesting greater economic efficiency. In the ecological scenario, some tools are suggested to sustainability as applied creativity in the use of natural resources with minimal damage to ecological systems, the replacement of finite resources with renewable, reducing the volume of waste and pollution through energy conservation and recycling, limiting the consumption of natural inputs, intensification of technological research and suitability in accordance with international standards of environmental protection.

Developed from a holistic view, Design for Environment (DFE) has guidelines to reduce manufacturing costs, reduce waste, satisfaction of customer demand as environmental responsibility, new sources of income and resources and encouraging culture changes in an organization (OF, 2009). Telenko et al (2009) complement the DFE with six principles: sustainable resources, features clean, waste reduction and pollution, minimize the consumption of resources and materials during use, durability of products and components and end-of-life process.

Das (2009), to schematize the steps of the DFE, allows the vision of three complementary sets of activities. The main part begins of the whole manufacturing to product use, decline and subsequent disposal in the environment, acquisition and processing of raw materials to restart the manufacturing cycle. The second set also part of the manufacture, use and declining product being recycled and returns to the manufacture. Finally, the third set after manufacture, and use have been declining reuse, as shown in figure 8.

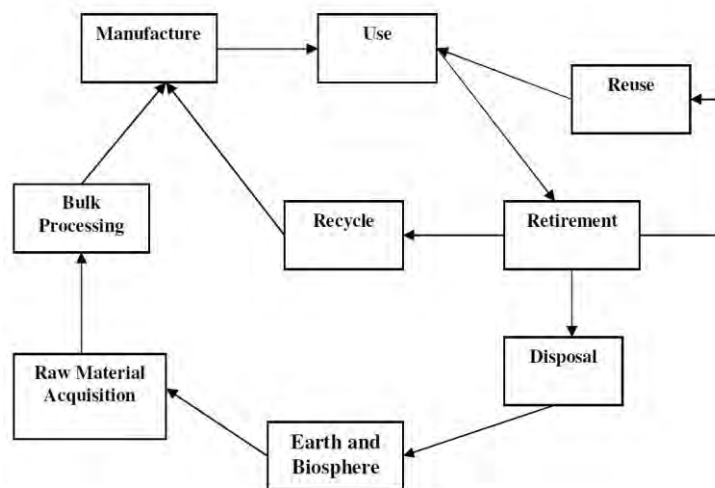


Figure 8. DFE Life Cycle (DAS, 2009)

The DFE has a direct relationship with the Life Cycle Analysis (LCA) of a product, a method used to quantify the environmental impact, which begins with the selection of materials to reach the end of its useful life (TELENKO et al, 2009). The tailings are considered unused resources, and therefore, should be minimized or incorporated into another chain.

3. CONCEPTUAL APPLICATION OF ARTISANAL BRAIDING TECHNIQUES IN PACKAGING DEVELOPMENT

Brazil needs good packaging to add value and improve the competitiveness of their products, making the design a decisive factor for success. It is necessary to have a design method that adopts a study to design good products. The methodology is used as a basis for further progress, considering function, technical characteristics and production system, market and consumer need, representing an important role in a globalized world.

It is intended with the use of a methodology to organize and orchestrate a systematic application to the development of packaging, taking into consideration all the important aspects of the project, meeting positively to the objectives established for the product to be packed.

According to Papanek (2000), the inclusion of alternative technologies and local culture enables the modification of a manufacturing process, and beyond the technical production, cost and market demand, the ecosystem in which the product is inserted should be considered design parameter. The traditional handicraft techniques indicate the potential for employment in different activities. The artisanal braiding, among other functions, can be constructed to store and

serve food solids and/or liquids. The artisanal braiding, shown below, has been taken from a pioneering research on the subject, treated by Ribeiro (1988).

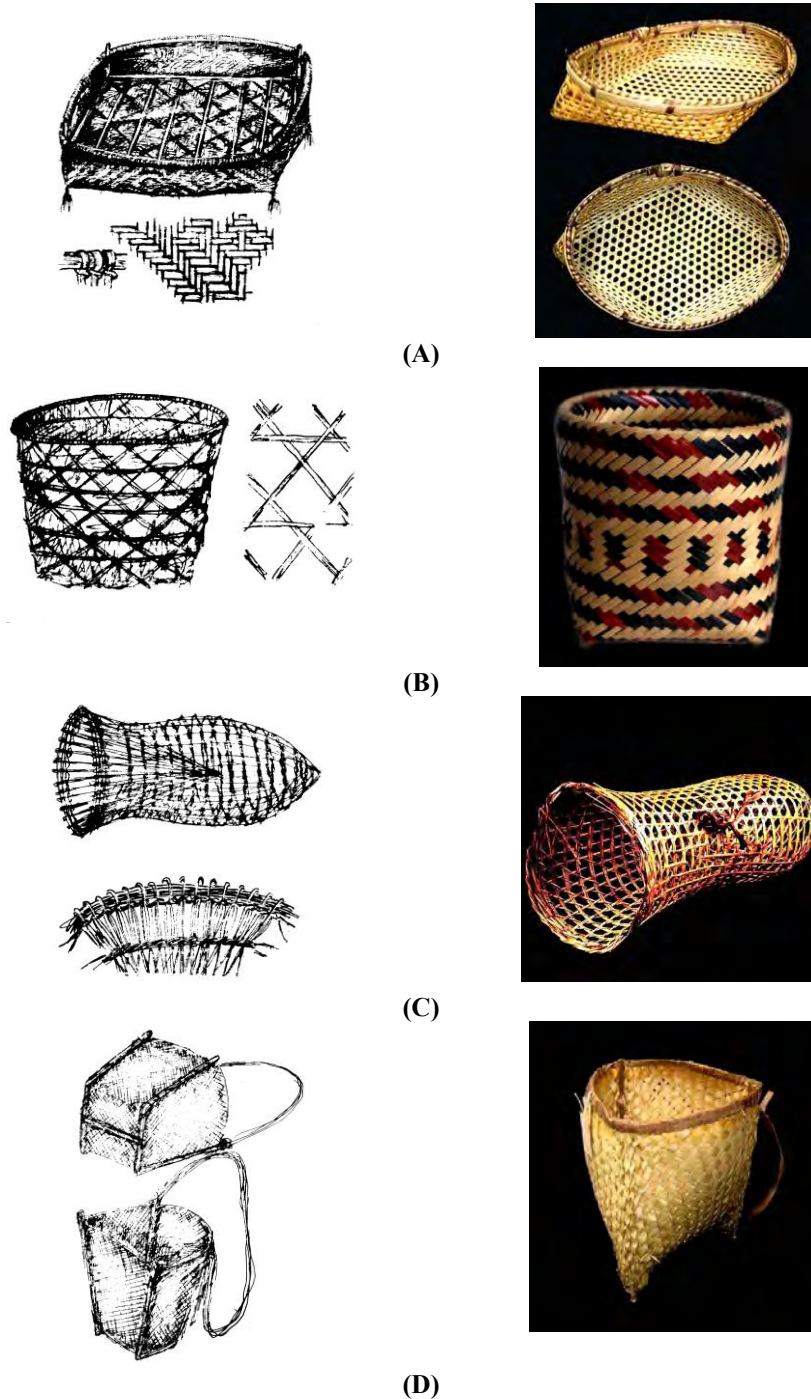


Figure 9. *Gameliforme* (A), *Paneiriforme* (B), *Nassa* (C), *Cesto-Cargueiro Quadrangular* (D)
(RIBEIRO, 1988; adapted ARARIBÁ, 2013)

On the market today are found certain types of products that make use of braiding as packaging to protect and transport food. In general, the packaging that contains grains uses closed frames, in which warp and weft are interweaved as many times as possible, whereas for fruit and vegetables is necessary the passage of water and air flow, besides being used rigid fibers with and a low interweaved frame, with therefore represents a greater product volume, as shown in figure 10.

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Figure 10. Hemp 4 Haiti by Blake Lowther (A); Pomelo's packaging by Yod (B)
 (The Dieline, 2012)

These examples show that researches are already being carried out in order to develop a packaging with natural fibers. However, the necessity of reducing the disposal of waste generated by packing, needs to be better exploited to provide new solutions without causing damage to the environment. The methodology used in the field is based on DFE and sustainable methods of production, which aims at the behavior of the production chain, on issues such as waste generated by disposal of packaging on the environment, without compromising quality or interfere with the efficiency of the products.

This research is based on the methodology described by Bucci et al (2007), which describes a model that proposes the integration of product design and packaging design. Based on this study, we propose the insertion of a Pre-Project along the planning stage, containing a description of the requirements of packing, braiding, application, consumer and disposal information, information that is relevant to other steps.

The information set out in the Pre-Project is generated from the interface between different areas, in a qualitative and quantitative methods to serve as guidelines for the preparation of a project aimed at reducing the cost and waste production, meet the required environmental needs, promote best solutions for post-use, enabling new applications of materials to maximize the use of packaging in order to promote greater protection in handling and transport, and thus reduce the risk of damage to the packaged product.

From these data it is intended to, by application of design tools, propose a package which exploits the use of the braiding that helps the individual to protect and carry fruits and vegetables in a single device with greater security, without interfering with the quality of the product, and thus reduce the excessive use of packaging that will be discharged to the environment.

4. CONCLUSIONS

This study allowed the visualization of the requirements involved in the packaging design and the influences the production process. In the case of handicraft activity, cultural aspects, social and environmental parameters should be considered in the development of new packaging generated from this technique.

Plant fibers, natural resources chosen as raw material, reinforce the combination of sustainability and functionality, main focus of this research. Besides being a natural resource, its use creates jobs for local communities, providing an alternative source of income and rescue of traditional techniques. The concern for environmental preservation is a strong limiting condition in the packaging sector. Thus, researchers cannot ignore, in any case, the destination of post-consumer packaging.

It is important to make a risk analysis to change the design of packaging, because the modification of one packet can cause major damage to the product transported, leading to a total loss of food. Therefore this proposal seeks, by optimizing the design of packaging and rescue of materials and traditional Brazilian techniques, the balance of environmental impact during the production process.

Some attitudes, at the time of purchase, on handling carefully fruits and vegetables, avoid squeezing products and packaging carefully to avoid kneading, especially most delicate products, together with appropriate packaging, generates less food waste.

In conclusion, the suggested methodology with the support of design tools, including environmental variables from the beginning of the project, using sustainable materials, reducing the use of disposable packaging and making use of reusable packaging, are attitudes that will lead to a gain in quality and cost reduction, plus great benefits and a shorter time in the development of the project and, as a consequence, the reduction of environmental impacts.

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6. REFERENCES

- ABRE. “Associação Brasileira de Embalagens”. 15 Abr. 2013 <[www.abre.org.br/setor/dados-de-mercado/ texto internet](http://www.abre.org.br/setor/dados-de-mercado/texto_internet) >
- ARARIBÁ. “Museu de Arte Indígena”. 20 Jan. 2013 <<http://www.araribah.com.br/>>
- Asimow, M., 1968. *Introdução ao Projeto*. Trad. José Wanderley Coêlho Dias. São Paulo: Mestre Jou.
- Ballou, R.H., 2001. *Gerenciamento da cadeia de suprimentos: planejamento, organização e logística empresarial*. Porto Alegre: Bookman, 532 p.
- Bitencourt, A., 2001. *Desenvolvimento de uma metodologia de reprojeto de produto para o meio ambiente*.
- Brundtland, G. H.; 1987. *World Commission On Environment And Development. Our common future*. Oxford: Oxford University Press.
- CEAGESP “Perdas: problemática e solucionática”. 1 Abril 2013 <<http://www.ceagesp.gov.br/>>
- Carvalho, M. A., 2008. *Engenharia de embalagem: uma abordagem técnica do desenvolvimento de projeto de embalagem*. São Paulo: Novotec.
- Das, C., 2009. “Competitive Advantage Through Design for Environment”. *Journal of Engineering Innovation and Research*, v. 1, issue 2, 3p.
- Demaria, K; 2000. *The packaging development process: a guide for engineers and project managers*. Lancaster : Technomic Publishing.
- Bucci, D. Z.; Forcellini, F. A. “Sustainable packaging design model”. In: *Complex Systems Concurrent Engineering*. Springer London, 2007. p. 363-370.
- FUNARTE. 1986. *Artesanato Brasileiro*. FUNARTE.
- Griffin JR, RC. 1985. “Materials and package testing”. In: *Principles of package development*. 2. ed. Connecticut: Avi Publishing Company Inc; p.130-167.
- Gurgel, F. A., 2007. *Administração da embalagem*. São Paulo: Thomson Learning.
- Junior, R.T. “Alguns aspectos da embalagem e a necessidade da interação do marketing com outras áreas da organização”. 5 Maio.2011 <<http://br.monografias.com/trabalhos913/embalagem-marketing-organizacao/embalagem-marketing-organizacao.shtml>>.
- Kotler, P., 1998. *Administração de marketing: análise, planejamento, implementação e controle*. São Paulo: Atlas. cap.15, p.382-411.
- Levy Neto, F., 2006. *Compósitos estruturais: ciência e tecnologia* / Flaminio Levy Neto, Luiz Claudio Pardini. – 1.ed. – São Paulo: Edgard Blucher,
- Luengo, R.F.; Calbo, A.G., 2006 “Embalagem para comercialização de hortaliças e frutas”. *Embalagens para comercialização de hortaliças e frutas no Brasil*. Brasília: Embrapa Hortaliças, 2010. cap. 44.
- Martins, S., 1973. *Contribuição ao estudo científico do artesanato*. Imprensa Oficial do Estado de Minas Gerais.
- Mestriner, F., 2002. *Design de Embalagem – Curso Básico*, 2 ed. Revisada. São Paulo: Pearson Makron Book.
- Moura, R.A.; Banzato, J.M., 2008. *Embalagem, utilização & containerização*. 4ª ed. São Paulo: IMAM, 2006
- Negrão, C.; De Camargo, E., 2008. *Design de embalagem: do marketing à produção*. Novatec Editora.
- Pahl, G.; Beitz, W.; Feldhusen, J.; Grote, K. H., 2007. *Engineering design: a systematic approach*. Springer-Verlag London Limited,
- Paine, F.A., 1996. *The packaging Design and Performance*. Surrey: Pira.
- Papanek, V., 2000. *Design for the Real World: Human Ecology and Social Change*. Chicago: Thames and Hudson, 394p.
- Ribeiro, B., 1988. *Dicionário do Artesanato Indígena*. Ed. Itatiaia, 343p.
- Ribeiro, L., 1984. *Introdução à tecnologia têxtil*. CETIQT/SENAI.
- Romano, L.N., 1996. “Metodologia de projeto de embalagem”. *Dissertação (Mestrado em Engenharia Mecânica)- Universidade Federal de Santa Catarina, Florianópolis*.
- Sachs, I., 2008. *Caminhos para o desenvolvimento sustentável*. Rio de Janeiro: Garamond.
- SEBRAE, 2004. *Programa sebrae de artesanato: Termo de referência*. Brasília: SEBRAE, p. 99.
- Seraine, A.B.M dos S., 2009. “Ressignificação produtiva do setor artesanal na década de 1990: o encontro entre artesanato e empreendedorismo”. *Tese (Doutorado). Universidade Estadual de Campinas*.
- Telenko, C.; Seepersad, C. C.; Webber, M. E., 2009. “A Method for Developing Design for Environment Guidelines for Future Product Design”. In: *Proceedings of the ASME 2009 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference*. San Diego, California, USA.
- Ten Klooster, R., 2002. *Packaging design: a methodological development and simulation of the design process*. Thesis, Delft University of Technology, Delft.
- The Dieline. “Hemp 4 Haiti”. 20 Jan. 2011 <<http://www.thedieline.com/blog/2011/9/22/hemp-4-haiti.html>>

Marília Colozio Favaro, Adriana Yumi Sato Duarte, Franco Giuseppe Dedini
Study of the Application of Brazilian's Artisanal Braiding in Packaging Design for Fresh Food.

The Dieline. "Eco&Sustainable Premium Thai Pomelo Packaging". 20 Jan. 2011

<<http://www.thedieline.com/blog/2011/9/22/hemp-4-haiti.html>>

Toga., 1985. *Embalagem, arte e técnica de um povo*. São Paulo: Toga.

Ullman, D., 1997. *The Mechanical Design Process*. 2ed, 340p.

Vezzoli, C.; Manzini, E., 2008. *Design for environmental sustainability*. Springer.

Voxpopuli, 2010. *Relatório de pesquisa: Centro cape*. Relatório técnico, VOXPOPULI.

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