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FOOD PACKAGING: MATERIALS, PROPERTIES, MANUFACTURING AND CHALLENGES FOR SUSTAINABILITY IN MOZAMBIQUE

EMBALAGENS DE ALIMENTOS: MATERIAIS, PROPRIEDADES, FABRICAÇÃO E DESAFIOS PARA A SUSTENTABILIDADE EM MOÇAMBIQUE

ENVASES DE ALIMENTOS: MATERIALES, PROPIEDADES, FABRICACIÓN Y DESAFÍOS PARA LA SOSTENIBILIDAD EN MOZAMBIQUE

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ABSTRACT

Packaging is a strategic element in the food value chain, going beyond simple packaging to include protection, preservation, transportation, communication, and marketing. This chapter reviews the main packaging materials—metal, plastic, glass, cellulose, and wood—highlighting their properties, manufacturing processes, applications, and limitations. It also addresses the issue of compound migration, food safety risks, quality control methods, and the importance of recycling and sustainability in the sector. Globally, there is a drive for smart, biodegradable packaging and returnable systems aligned with the circular economy. However, in Mozambique, one of the biggest challenges remains limited access to adequate packaging, both due to dependence on imports and the lack of local processing industries. As a result, much of the post-harvest agricultural and horticultural produce is sold or stored unprotected, often exposed to the elements, which increases losses, reduces quality, and compromises food safety. The Mozambican legal framework, defined by Decree No. 15/2006, Ministerial Order No. 247/2011, and the recent Order No. 26/2025, establishes standards for labeling, safety, and sustainability. However, structural limitations persist in inspection and laboratory control, especially in migration and certification testing. Cases such as the use of returnable bottles by Cervejas de Moçambique and the ISO 22000 certification of Água da Namaacha demonstrate significant progress, but are still limited to large companies. Therefore, strengthening the packaging industry in Mozambique, combined with public incentive policies, training programs, and investment in quality laboratories, is essential to reduce post-harvest losses, add value to products, and promote the country's competitiveness in domestic and international markets.

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RESUMO

A embalagem constitui um elemento estratégico na cadeia de valor dos alimentos, indo além da simples função de acondicionamento para atuar na proteção, conservação, transporte, comunicação e marketing. Este capítulo revisa os principais materiais de embalagens metálicas, plásticas, de vidro, celulósicas e de madeira destacando suas propriedades, processos de fabricação, aplicações e limitações. Aborda-se ainda a problemática da migração de compostos, os riscos para a segurança alimentar, os métodos de controle de qualidade e a importância da reciclagem e sustentabilidade no setor. No contexto global, observa-se a busca por embalagens inteligentes, biodegradáveis e sistemas de retornabilidade, alinhados à economia circular. Contudo, em Moçambique, um dos maiores desafios continua sendo o acesso limitado a embalagens adequadas, tanto pela dependência de importações como pela carência de indústrias locais de transformação. Como consequência, grande parte da produção agrícola e hortícola pós-colheita é comercializada ou armazenada sem proteção, frequentemente exposta ao relento, o que aumenta perdas, reduz a qualidade e compromete a segurança alimentar. O enquadramento legal moçambicano, definido pelo Decreto n.º 15/2006, pelo Diploma Ministerial n.º 247/2011 e pelo recente Diploma n.º 26/2025, estabelece normas de rotulagem, segurança e sustentabilidade. Contudo, persistem limitações estruturais na fiscalização e no controlo laboratorial, especialmente em ensaios de migração e certificação. Casos como a utilização de garrafas retornáveis pela Cervejas de Moçambique e a certificação ISO 22000 da Água da Namaacha mostram avanços importantes, mas ainda restritos a grandes empresas. Assim, o fortalecimento da indústria de embalagens em Moçambique, aliado a políticas públicas de incentivo, programas de capacitação e investimento em laboratórios de qualidade, é essencial para reduzir perdas pós-colheita, agregar valor aos produtos e promover a competitividade do país nos mercados interno e externo.

Palavras-chave: Embalagens. Segurança Alimentar. Pós-colheita. Sustentabilidade. Moçambique.

RESUMEN

El embalaje es un elemento estratégico en la cadena de valor alimentaria, yendo más allá del simple embalaje para incluir protección, conservación, transporte, comunicación y marketing. Este capítulo revisa los principales materiales de embalaje (metal, plástico, vidrio, celulosa y madera), destacando sus propiedades, procesos de fabricación, aplicaciones y limitaciones. También aborda el problema de la migración de compuestos, los riesgos de inocuidad alimentaria, los métodos de control de calidad y la importancia del reciclaje y la sostenibilidad en el sector. A nivel mundial, existe un impulso para envases inteligentes, biodegradables y sistemas retornables alineados con la economía circular. Sin embargo, en Mozambique, uno de los mayores desafíos sigue siendo el acceso limitado a envases adecuados, tanto por la dependencia de las importaciones como por la falta de industrias de procesamiento locales. Como resultado, gran parte de los productos agrícolas y hortícolas poscosecha se venden o almacenan sin protección, a menudo expuestos a los elementos, lo que aumenta las pérdidas, reduce la calidad y compromete la inocuidad alimentaria. El marco legal mozambiqueño, definido por el Decreto n.º 15/2006, la Orden Ministerial n.º 247/2011 y la reciente Orden n.º 26/2025, establece normas de etiquetado, seguridad y sostenibilidad. Sin embargo, persisten limitaciones estructurales en la inspección y el control de laboratorio, especialmente en las pruebas de migración y certificación. Casos como el uso de botellas retornables por parte de Cervejas de Moçambique y la certificación ISO 22000 de Água da Namaacha demuestran avances significativos, pero aún se limitan a las grandes empresas. Por lo tanto, el fortalecimiento de la industria del envasado en Mozambique, junto con políticas públicas de incentivos, programas de capacitación e inversión en laboratorios de calidad, es esencial para reducir las pérdidas poscosecha, agregar valor a los productos y promover la competitividad del país en los mercados nacionales e internacionales.

Palabras clave: Envasado. Seguridad Alimentaria. Poscosecha. Sostenibilidad. Mozambique.

1 INTRODUCTION

Packaging is one of the most strategic elements in the food production and consumption chain. Its function goes beyond simple packaging: it involves protection against physical, chemical and biological agents; the conservation of sensory and nutritional quality; the facilitation of transport and storage; and communication with the consumer, either through mandatory labeling or marketing strategies.

Historically, the evolution of packaging has followed technological development and changes in consumption habits. From glass and metal to synthetic polymers and cellulosic materials, the diversity of solutions reflects not only industrial advances, but also the growing concern for food safety, sustainability and logistical efficiency.

However, the use of packaging presents global challenges: the migration of toxic compounds, the dependence on non-renewable raw materials, the environmental impact caused by the improper disposal of plastics, and the need to strengthen recycling and returnability systems. In response, innovation trends such as smart, biodegradable and biopolymer-based packaging are emerging, aligned with the principles of the circular economy.

In the Mozambican context, issues related to packaging take on even more critical contours. One of the country's biggest challenges is limited access to adequate packaging, which is reflected in high post-harvest losses, especially in fruits, vegetables and other perishable products, which are often sold or stored outdoors (figure 01). This shortage is the result of dependence on imports, high costs and reduced local capacity for the production of packaging materials. While large companies, such as Cervejas de Moçambique and Água da Namaacha, already adopt modern systems of returnability and quality certification, most small producers and traders lack affordable and sustainable alternatives.

Figure 1

Sale of food products in the wholesale market of Waresta

Source: Authors, 2025.

In addition, Mozambique has important legal instruments, such as Decree No. 15/2006, Ministerial Diploma No. 247/2011 and the most recent Diploma No. 26/2025, which introduces the Environmental Tax on packaging. However, the effective implementation of these standards still faces limitations in inspection, specialized laboratories and the inclusion of small and medium-sized companies in the certification processes.

Given this scenario, studying packaging materials, their functions, properties, risks, and trends is essential not only to understand the global reality, but also to propose solutions adapted to the Mozambican context. This knowledge can subsidize public policies, technological innovation, and business strategies that contribute to reducing losses, adding value, and promoting the sustainability of the food chain in the country.

2 PACKAGING CONCEPTS

Packaging is technically defined as wrappers or containers intended to hold, preserve, and protect food during transportation, storage, and consumption. Its main function is to preserve the integrity and quality of the product until the moment it reaches the final consumer. From an economic point of view, packaging must "protect what it sells and sell what it protects", reinforcing both its function as a barrier against external agents and its role in marketing and commercial differentiation.

The classification of packaging can occur according to different criteria. As for use, there are primary ones, which come into direct contact with food, such as cans, bottles and plastic bags; secondary packaging, which groups primary packaging, such as cardboard boxes and cartridges; and tertiary ones, intended for transport and logistics, such as pallets and containers. As for stiffness, they can be rigid, semi-rigid or flexible. In relation to the material, metallic, plastic, glass, cellulosic and wood stand out. In Mozambique, many products in informal trade use improvised or reused primary packaging, while formal firms tend to employ more standardized solutions; this reality is partially documented in plastic waste studies that show high volumes of mismanaged materials. For example, estimates from the Life Cycle Assessment of Plastic Waste Management in Mozambique study indicate that in 2020, around 480,000 tons of plastic waste are generated in the country, with more than 70% remaining without formal collection. https://link.springer.com/article/10.1007/s10163-024-02098-z?utm_source=chatgpt.com

3 FUNCTIONS OF FOOD PACKAGING

The functions of packaging include containment, protection, conservation, transport and promotion. Containment ensures that the product is properly maintained, preventing loss or dispersion; the protection protects against shocks, light, oxygen, humidity and microorganisms; conservation extends shelf life by maintaining physical, nutritious and sensory properties; transportation and storage facilitate logistics; Finally, promotion and consumer information through labeling, marketing or design play an essential role. In the Mozambican context, protection is of critical importance, as many perishable products, such as fruits and vegetables, are left out in the open or sold without proper packaging, accelerating post-harvest losses, poor quality and reduced market value. Although there are no specific published statistics to date for post-harvest losses associated with the lack of modern metal/plastic/glass packaging, estimates of plastic waste (≈ 116,000 tons discarded per year without proper treatment in 2025) highlight the structural problem of disposal and environmental management that is also reflected in quality losses of perishable foods. https://clubofmozambique.com/news/mozambique-discards-annually-116000-tonnes-of-plastic-284183/?utm_source=chatgpt.com

4 FOOD PACKAGING MATERIALS

Metal packaging, manufactured from aluminum, a very light non-ferrous material, easy to transform and with good resistance to atmospheric oxidation and steel (-FF tinplate, chrome sheet, Stancron sheet and uncoated sheet), stand out for their high mechanical resistance and efficient barrier against oxygen and light, being widely used in preserves, energy drinks and soft drinks.

Metal packaging is widely used in the food industry due to its physicochemical and mechanical properties. Among them, aluminum (Figure 02B) and steel (Figure 02A) stand out, which have distinct characteristics and complementary applications. Aluminum is a low-density non-ferrous metal, easily formable and with high resistance to atmospheric oxidation, and is widely used in the manufacture of packaging. On the other hand, steel sheets (FF tinplates, chrome plates, Stancron sheets and uncoated sheets), consisting essentially of iron and carbon, are characterized by high mechanical strength and durability, and are used in the production of food packaging with various structures. Although steel has a higher susceptibility to corrosion when compared to aluminum, its robustness and relatively low cost justify its wide use in structural applications.

Metal packaging for food is broadly classified into two main types: three-piece packages (Figure 02A) and two-piece packages (Figure 02B). The former consist of a body, lid and bottom, and are commonly manufactured in tinplate. Two-piece packages, on the other hand, have the body and bottom integrated into a single structure, requiring only the application of a lid. This type of packaging can be produced in tinplate, chrome foil or aluminum foil, materials that are distinguished by their composition, resistance to corrosion and suitability for the type of food packaged.

The main metallic materials used in the manufacture of food packaging are tinplate, chrome foil, and aluminum foil, each with specific properties and applications (Zhou et al., 2020).

Tinplate has very good corrosion resistance, good sulfuration resistance, good weldability, and good formability, and is widely used in the production of two- and three-piece cans, as well as metal caps. Its cost is considered average, which makes it a balanced option between performance and economic viability (Zhou et al., 2020). Chrome plate, on the other hand, also has very good corrosion resistance and excellent sulfuration resistance, although it has poor weldability. It stands out for its good forming capacity and low cost, being used mainly in the manufacture of two-piece cans and lids (Kumar et al., 2023). Aluminum foil, on the other hand, offers very good formability and good resistance to sulfuration, but has low corrosion resistance when compared to other materials. Despite this, it is widely used in two-piece cans, easy-open lids, and tubes, due to its lightness, excellent barrier against light, gases, and moisture, as well as being recyclable and safe for food contact (Okorie et al., 2023; Taroco et al., 2024). The choice of material therefore depends on the desired properties in the final product, the type of food to be packaged, and the balance between mechanical strength, cost, and corrosion protection (Zhou et al., 2020; Okorie et al., 2023).

However, they are susceptible to corrosion, which requires the use of internal coatings. In Mozambique, the production of canned fish, such as tuna and sardines, uses this type of packaging, although the metal raw material is largely imported.

Figure 2

Steel (A) and Aluminum (B) metal packaging

The **B**

Source:https://id.pngtree.com/freepng/empty-tin-can-tinned_13115417.html; https://mundolatas.com/pt-br/embalagem-dois-pecas-dwi/

Plastic packaging, in turn, is the most versatile and economically accessible, being produced from polymers such as polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC) and polystyrene (PS). They are lightweight, transparent and moldable in different shapes, which makes them widely used in cereal bags, soft drink bottles and snack packaging. However, they have a strong environmental impact due to the low degradation rate and the risk of additive migration.

Plastic packaging can be produced by different industrial processes, including extrusion, thermoforming, injection, and blow molding, as well as injection-blow molding and co-extrusion combinations (Silva et al., 2021; Zhang et al., 2022). In the extrusion process, plastic resin is melted and molded into films, sheets, or tubes, and can be combined with other polymers to form multilayer structures with better barrier properties (Martins & Oliveira, 2020). Thermoforming uses previously extruded sheets, heated to the point of softening and molded by vacuum and pressure, and is common in the production of cups, jars, and trays (García et al., 2023). Injection molding is widely used in the manufacture of high-precision parts, such as caps and containers, due to its ease of automation and low operating cost (Ramos et al., 2022). Blow molding and injection-blow molding are mainly used in the production of bottles, where compressed air conforms the molten plastic in the mold, ensuring good dimensional accuracy and finish (López & Navarro, 2021). In many applications, different materials are combined by co-extrusion, lamination, or coating (metallization), associating polymers, aluminum, and paper to improve the strength, protection, weldability, and printing properties of the packaging (Fernandes et al., 2024; Zhou et al., 2020). In Mozambique, the indiscriminate use of disposable plastic bags in informal commerce has led the government to adopt legal restrictions to mitigate environmental impacts, Coca-Cola Beverages Africa (CCBA) through its PET program has increased the daily amount collected for recycling by about 10 tons/day, creating jobs for hundreds of people. https://www.ccbagroup.com/investment-in-recycling-increases-collection-by-10-tons-a-day/?utm_source=chatgpt.com

The glass packaging, composed of sand, barrel, limestone and recycled shards, offers a total barrier against gases and is fully recyclable and reusable. Its manufacture begins with the inspection of raw materials, evaluating granulometry, density and moisture, ensuring the reproducibility of the process. After approval, the materials are stored in silos, dosed and mixed with precision, including the addition of water and recycled shards. The mixture is then melted in crucible or tank furnaces, reaching temperatures of 1400–1550 °C to obtain a malleable vitreous bath. Then, the mass undergoes refining and conditioning to eliminate gases and homogenize the viscosity. Molding occurs by the blow-blow or pressure-blow process, determining the final shape of the bottles or jars. After forming, the containers are treated on the surface by heat, applying metallic coatings to increase resistance to internal pressure and mechanical shocks. Subsequently, annealing reduces internal stresses, ensuring dimensional stability and thermal resistance. Finally, cold surface treatment is applied, usually with emulsions or fatty acids, to reduce friction, facilitate transport and handling without compromising labeling. Despite their fragility and weight, they remain widely used in beers, soft drinks, wines and olive oils. Cervejas de Moçambique is a success story in the adoption of returnable bottle systems, reducing dependence on imports and production costs.

Cellulosic packaging, produced from paper, paperboard and corrugated cardboard, stands out for its low cost, ease of printing and recyclability, although it has low resistance to moisture. Paper production involves several stages, highlighting the disaggregation of the fibers, the preparation of the pulp, the formation of the sheet, the finishing and the transformation into final products. Disaggregation can occur by mechanical, chemical or semi-chemical methods. In the mechanical method, the wood is crushed and mixed with water, resulting in high yield (90–95%), but with damaged fibers, suitable for low-strength papers such as newspapers. The chemical method selectively removes lignin and carbohydrates, producing high-purity pulp, used in packaging papers and bags. The semi-chemical process, on the other hand, combines mechanical and chemical treatments, generating intermediate resistance pulps, applicable to cardboard kernels. Paste preparation includes defibering, adding additives, bleaching, and mechanical refinement to adjust strength and physical properties. Paper formation occurs in Fourdrinier machines or cylinders, where the pulp is deposited, drained and partially dried, allowing homogeneous or multilayer sheets to be obtained, depending on the type of product. Then, pressing and drying are carried out in heated cylinders, followed by surface treatments that may include calendering, coatings with polyethylene, paraffins, or pigments to provide brightness, smoothness, and barrier properties. The transformation of paper and cardboard involves printing, laminating, corrugating, cutting and creasing, giving specific characteristics for different applications. Corrugated cardboard is formed by gluing the corrugated core to external covers, adjusting the pressure so as not to damage the structure of the waves, ensuring resistance and uniformity. The final products include heat-sealable or glued bags, simple boxes, displays, multipacks and liquid packaging with laminated plastic and aluminum structures, as well as blister packs and composite cans.

In the country, they are widely used to package fruits destined for export, such as mangoes and bananas, although improvised solutions still predominate in the domestic market.

Finally, wooden packaging, traditionally used in the packaging of fruits and vegetables, offers robustness and the possibility of reuse, but presents risks of contamination by pests and high weight. In Mozambique, they continue to be used in local markets, but have been progressively replaced by cardboard or rigid plastic alternatives.

5 COMPONENT MIGRATION AND FOOD SAFETY

Food safety is directly related to the migration of components from packaging to food. Compounds such as heavy metals (lead, cadmium, mercury), plasticizers, bisphenol A, phthalates, and paints can migrate, depending on the composition of the packaging, the food, and the storage conditions.

To monitor this risk, global and specific migration assays are performed with food simulants, such as water, 3% acetic acid solution, 15% alcohol solution, and refined olive oil or n-heptane (tables 1 and 2). The determination of heavy metals is generally done by atomic absorption spectrometry (INSTITUTO ADOLFO LUTZ, 2008).

Table 1

Conditions for testing

CONDIÇÕES DE CONTACTO NO USO REAL	CONDIÇÕES DE ENSAIO				
	Simulante A	Simulante B	Simulante C	Simulante D	
	Água	Ácido acético a 3%	Álcool a 15%	Heptano **	Azeite de oliva *
A. Conservação (contacto prolongado, t > 24 h)					
T < 5°C	5°C/10 dias	5°C/10 dias	5°C/10 dias	5°C/30 min	5°C/10 dias
5°C < T < 40°C	40°C/10 dias	40°C/10 dias	40°C/10 dias	20°C/30 min	40°C/10 dias
B. Contacto breve (2 h < t < 24 h)					
À temperatura ambiente	40°C/24 h	40°C/24 h	40°C/24 h	20°C/15 min	40°C/24 h
C. Contacto momentâneo (t < 2 h)					
À temperatura ambiente	40°C/2 h	40°C/2 h	40°C/2 h	20°C/15 min	40°C/2 h
D. Elaboração					
40°C < T < 80°C	80°C/2 h	80°C/2 h	80°C/2 h	40°C/15 min	80°C/2 h
80°C < T < 100°C	100°C/30 min	100°C/30 min	-	50°C/15 min	100°C/30 min
T > 100°C	120°C/30 min	120°C/30 min	-	60°C/15 min	120°C/30 min

Source: Brazil, 1999.

Table 2

Conditions for migration trials

CONDIÇÕES DE CONTACTO NO USO REAL	CONDIÇÕES DE ENSAIO			
	Simulante A	**Simulante B**	**Simulante C**	**Simulante D**
	Água	Ácido acético a 3% (m/v)	Álcool a 15% (v/v)	Heptano **
A. Contacto prolongado, t > 24 h				
T < 5°C	20°C/48 h	20°C/48 h	20°C/48 h	20°C/30 min
5°C < T < 40°C	50°C/24 h	50°C/24 h	50°C/24 h	20°C/30 min
B. Contacto breve (2 h < t < 24 h)				
À temperatura ambiente	40°C/24 h	40°C/24 h	40°C/24 h	20°C/15 min
C. Contacto momentâneo (t < 2 h)				
À temperatura ambiente	40°C/2 h	40°C/2 h	40°C/2 h	20°C/15 min
D. Elaboração				
40°C < T < 80°C	65°C/2 h	65°C/2 h	65°C/2 h	40°C/30 min
80°C < T < 100°C	100°C/30 min	100°C/30 min	-	50°C/30 min
T > 100°C	120°C/30 min	120°C/30 min	-	65°C/ 2 h
E. Envasado a quente				
T>70°C	À T de ebulição e esfriar a 38°C	À T de ebulição esfriar a 38°C	-	50°C/15 min

**In the case of paraffin-coated cellulosic material, the total migration test with the n-heptane simulant is not required
Source: Brazil, 1999.

However, in Mozambique, the application of these tests faces significant obstacles. The lack of ISO 17025 accredited laboratories limits the systematic performance of migration analyses, restricting them to large companies that use international laboratories or specialized services such as those of SGS Mozambique. Small and medium-sized producers rarely have access to these tools, which increases food security risks. So far, no recent data (2020-2025) specific migration in Mozambican foods have been published for each type of packaging (metal, plastic, etc.), which highlights a critical research gap.

6 PACKAGING RECYCLING

Recycling is an essential component of sustainable packaging management. Glass can be recycled infinitely while maintaining its original properties, which makes it a highly advantageous material. Metals, such as aluminum and steel, are also recyclable, although they rely on efficient collection systems and reverse logistics. Plastics, on the other hand, still have low overall recycling rates, and in Mozambique the situation is more critical, as there are no structured selective collection systems. Cellulosic materials can be reused, but suffer quality degradation after successive recycling cycles.

When it comes to recycling, Mozambique faces one of the biggest challenges in the improper disposal of plastics, with an estimated 116,000 tons of plastic discarded annually without proper treatment by 2025; only about 1% of these materials are recycled. https://clubofmozambique.com/news/mozambique-discards-annually-116000-tonnes-of-plastic-284183/ Reverse logistics projects are beginning to emerge, such as the CCBA, which subsidizes PET collectors and values returnable plastics, promoting jobs and local income. https://www.ccbagroup.com/investment-in-recycling-increases-collection-by-10-tons-a-day/?utm_source=chatgpt.com. CDM with returnable glass bottles also illustrates this trend; however, the infrastructure for recycling and repurposing remains insufficient to cover the entire country.

In Mozambique, recycling occurs predominantly informally, with waste pickers collecting materials from markets and dumps. Although this process contributes to income generation in vulnerable communities, the absence of consistent public policies and an organized reverse logistics infrastructure prevents the expansion of the sector and limits environmental benefits.

7 LEGISLATION AND QUALITY CONTROL IN MOZAMBIQUE

The Mozambican legal framework for food packaging is based on three main instruments: Decree No. 15/2006, which regulates the hygiene and labelling of foodstuffs; Ministerial Diploma No. 247/2011, which establishes mandatory labelling requirements for food products; and Ministerial Diploma No. 26/2025, which introduced the Environmental Tax on packaging, with the aim of encouraging sustainable practices.

The National Institute for Standardization and Quality (INNOQ) is the body responsible for implementing standards, assessing conformity and certifying products. The Conformity Assessment Program (PAC) requires certification of imported packaging and food, but its application faces practical difficulties. In addition, the shortage of specialized laboratories in the country limits the ability to perform migration assays and advanced analyses.

In practice, only large companies, such as Água da Namaacha, have been able to obtain international certifications such as ISO 22000, covering processes from production to packaging. Small and medium-sized companies, on the other hand, face obstacles related to the high cost and absence of accessible laboratory services, which highlights an urgent need for inclusion and strengthening of quality infrastructure in the country.

8 CONCLUSION

Food packaging is a strategic and multifunctional element in the production chain, acting not only in the protection and conservation of products, but also in transportation, communication and value addition. The review of metallic, plastic, glass, cellulosic and wood packaging materials shows that each type has advantages and limitations in terms of resistance, barrier to external agents, recyclability and suitability for local conditions in Mozambique.

The Mozambican context presents significant challenges, including dependence on imports, limited local production capacity, the absence of structured collection and recycling systems, as well as the scarcity of accredited laboratories for quality control and component migration tests. These factors result in high post-harvest losses, compromised food security, and restriction of the competitiveness of the agricultural and food sector.

Despite successful examples from large companies such as Cervejas de Moçambique, Água da Namaacha and logistics initiatives demonstrating the potential of sustainable practices and quality certification, there are still structural and regulatory gaps that limit the inclusion of small producers and traders.

Given this scenario, it is essential that Mozambique invests in strengthening the local packaging industry, technical training, the expansion of quality laboratories, and the implementation of public policies that promote sustainability, circular economy, and technological innovation. Only in this way will it be possible to reduce post-harvest losses, improve food security and increase the competitiveness of national products in the domestic and foreign markets.

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