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CORK – RAW MATERIAL

APCOR
Portuguese Cork Association

INDEX

MONTADO

"Montado" is the Portuguese term used to describe landscapes which are a specific, delicately-balanced ecosystem, comprising of mixed farming, centered around extensive cork oak woodlands, interspersed by areas of shrubs, grassland and cultivated fields.
Cork forests grow from sea level up to 500 m in the humid and warm climates of the Mediterranean basin, particularly in the southern regions of the Iberian Peninsula influenced by the Atlantic Ocean. Montados cover a worldwide area of 2.139.942 hectares. Portugal accounts for around 34 percent of the total worldwide area, corresponding to 736.775 hectares, approximately 23 percent of the country's forests, making it the dominant species. In Portugal, cork oaks are found mainly in Alentejo (84,1%), Central Portugal (6,3%), Algarve (4,6%), Lisbon and the Tagus Valley (3,3%), and Northern Portugal (1,7%). (Source: National Forestry Resources Department – National Forestry Inventory (IFN) 2005/2006 and 2010)
There are a number of reforestation programs which have brought about an average increase of 3,3% in forest areas over the last years. Over 130 thousand hectares were planted in Portugal and Spain with an approximate density of 120 to 150 cork oaks per hectare.
In addition to the above, in November 2015, in Lisbon, at Confederação dos Agricultores de Portugal (CAP) (Confederation of Farmers of Portugal) was presented the Agenda Portuguesa de Investigação e Inovação no Sobreiro e na Cortiça – Agenda 3i9 (portuguese agenda for research and innovation of cork oak tree and cork), based on a participatory process of consultation of the partners of Centro de Competências do Sobreiro e da Cortiça (CCSC) (Competence Centre for Cork Oak and Cork), from which the Portuguese Cork Association (Apcor) is part of. It involved 81 researchers and technicians from 27 entities in sectoral meetings. The main goal of this Agenda is to identify the means and resources available, setting goals and looking for results that could allow getting more and better cork, greater resilience of Portuguese cork oak forest and its production, investment in research and innovation that is designed in a period of three production cycles. In this process was identified a set of priority actions in several scientific fields, which integrate the structural lines of five functional plans nationwide, namely: national plan to improve productivity; national plan of defense against biotic agents; national plan of cork quality; and national plan for regional action. These plans require urgent implementation due to its economic impact on the productive and industrial sector.

CORK OAK TREE

The cork oak tree belongs to the oak genus (Quercus), hence its name Quercus Suber L., and is part of a sub-group which comprises European and Asian species - the Cerris group. It is a tree with a thick corky bark (cork), evergreen leaves and a natural size of 10 to 15 meters in height for adult trees.
As a species it is well suited to the Mediterranean climate, characterized by dry summers and mild winters - with temperatures ranging from -5ºC to 40ºC - with minimum yearly rainfall of 400mm, maximum yearly rainfall of 1700mm and a soil pH ranging from 4,8 to 7,0.
The cork oak is a remarkable tree, with great longevity and an enormous capacity for regeneration. It has an average lifespan of 200 years, despite the many cork harvestings to which it is subjected throughout its existence: around 15, at 9-year intervals.

WHAT IS CORK?

Cork is the bark of the cork oak tree. It is a vegetable tissue known in the botanical world as phellem, a part of the periderm (skin) system which covers the stem/trunk of the tree. Each year, a new periderm grows, consisting of rings growing outward from the tree, attaching itself to older ones, forming the bark of the tree.
Cork has unique and incomparable qualities which no ingenious human has yet been able to imitate or improve on:

- **Very light** – it weighs just 0,16 grams per cubic centimeter and can float;
- **Impermeable to liquids and gases** – thanks to the suberin and ceroids contained in the cell walls (see in chapter "chemical structure of cork"), cork is practically impermeable to liquids and gases. Its resistance to moisture enables it to age without deteriorating (for example, containers of wine have been discovered under the sea with their cork stoppers intact);
- **Elastic and compressible** – it can be compressed to around half its thickness without losing any flexibility, and recovers its shape and volume as soon as it is released. It is the only solid which, when compressed on one side, does not increase in volume on another; and as a result of its elasticity it is able to adapt, for example, to variations of temperature and pressure without suffering alterations;
- **An excellent thermal and acoustic insulator** – cork has low conductivity to heat, noise and vibration. This is because the gaseous components contained in cork are enclosed in small impermeable compartments, isolated from each other by a moisture-resistant substance.
- **Fire retardant** - cork is also a natural fire retardant: it burns without a flame and does not emit toxic gases during combustion.
- **Highly abrasion resistant** - cork is extremely resistant to abrasion and has a high friction coefficient. Thanks to its honeycomb structure, its resistance to impact or friction is greater than that of other hard surfaces.

But it is, above all, a material that is one hundred per cent natural, recyclable and reusable, essential qualities in a more environmentally friendly and less polluted modern society.

CHEMICAL STRUCTURE OF CORK

Cork cells have the shape of a pentagonal and sometimes hexagonal prism. The height of one of these tiny prisms is around 40 to 50 micrometers (thousandths of a millimeter). The smallest cells measure 20 or even 10 micrometers.
Following the invention of the optical microscope in 1660, English scientist Robert Hooke was the first person to observe the structure of cork and invented the word "cell", still used today.
On average, there are around 40 million cells in each cubic centimeter of cork, or approximately 800 million cells in a single cork stopper.
Around 80 percent of the composition of cork is gas contained in its cells. The cell walls, made of suberose, make cork practically impermeable to gases and liquids.
Suberin, the main component of cork, is a mixture of organic acids in the form of fat, or at least has a certain similarity to fats.
Its properties are notable: it is practically infusible and insoluble in water, alcohol, ether, chloroform, concentrated sulphuric acid and hydrochloric acid, among other substances.
The chemical composition of cork comprises a number of compounds, in the following average proportions:

- Suberin (45%) - the main component of the cork walls; responsible for the resilience of the cork;
- Lignin (27%) - the binding compound;
- Polysaccharides (12%) - components of the cork cells which help define the texture of the cork;
- Tannins (6%) - polyphenolic compounds responsible for color;
- Ceroids (5%) - hydrophobic compounds that ensure the impermeability of cork;
- Mineral water, glycerine, and others make up the remaining 4%.

FROM THE MONTADO TO THE RAW MATERIAL

CORK HARVESTING

The life cycle of cork as a raw material starts with the extraction of the bark from cork oaks, the so-called harvesting or stripping, which is carried out during the most active stage in the annual growth of the cork, from mid-May or early June to the end of August. However this period may vary depending on the weather (temperature, moisture, etc.). If it is windy or rainy, the cork cannot be removed from the tree.

Not many people know that it takes 20 to 25 years for cork oak trunk to start producing cork and be profitable. Each trunk has to reach a perimeter of 70cm when measured at 1,30m from the ground. From then on, the cork can be harvested from the tree for an average of 150 to 200 years, which corresponds to around 15 strippings.

The first stripping, which is known as "desbóia", produces cork of a very irregular structure which is too hard to be easily handled. This is the so-called virgin cork which will be used for applications other than cork stoppers (for example: flooring, insulation etc.), since its quality is far from that necessary to manufacture stoppers.

Nine years later, the second harvest produces material with a regular structure, less hard, but still not suitable for cork stoppers - this is known as secondary cork.

It is only from the third – when the cork oak has around 45years old - and subsequent harvests that the cork with the best properties is obtained, suitable for the production of quality corks, since its structure is regular with a smooth outside and inside. This is the so-called "amadia" or reproduction cork. From then on, the cork oak will supply good quality cork every nine years for around a century and a half.

The harvesting of the cork oak is an ancient process that can (and should) only be done by specialists, the debarkers, since much manual skill and experience is required in order not to harm the tree. The harvesting process consists of six steps and two men are needed for each tree:

1. Opening

A vertical cut is made in the cork, choosing the deepest crack in the cork bark. At the same time, the edge of the axe is twisted so as to separate the outer from the inner bark. The degree of difficulty of extraction can be gauged from the 'feel' of the axe. When the edge of the axe is applied to the strip, a hollow sound of tearing is heard if the cork is going to come off easily. If it is going to be difficult, the axe gives off a short, firm, dry sound.

2. Separation

The cork is then removed from the tree, by inserting the edge of the axe between the strip and the inner bark. The axe is twisted between the trunk and the cork strip to be extracted.

3. Division
A horizontal cut defines the size of the cork plank to be removed and what is to remain on the tree. During dividing, the inner bark is frequently marked and these mutilations can sometimes alter the geometry of the trunk.

4. Extraction
The plank is removed from the tree with care so that it does not split. The larger the planks extracted, the greater their commercial value. The removal of complete planks depends on the skill of the workers. After the first plank has been stripped, the operation is repeated over the whole trunk.

5. Removal
After the stripping of the planks, some fragments of cork remain attached at the base of the trunk. To remove any parasites in these “heels", the debarker gives them a few taps with his axe.

6. Marking
Finally, the tree is marked, using the last digit of the year in which the extraction took place.

SEASONING PERIOD
After the harvest, cork planks are stacked in piles either in the forest or in yards at a factory. There they remain exposed to sun, wind and rain. All these piles are constructed taking into account strict specific rules (defined by the International Code of Cork Stopper Manufacturing Practices - ICCSMP), so as to allow the cork to stabilize. The piles should be stacked on materials that do not contaminate the cork and prevent contact with soil. Wood, for example, is expressly prohibited because it can transmit fungi. During this seasoning period, the raw material matures and cork stabilizes. According to ICCSMP, the seasoning period for the planks should never be less than six months.
After this period, the cork enters the industrial process. The production of cork stoppers (both natural and technical), coverings and insulation follow different procedures (see the specific document for each product segment).

AVAILABILITY OF THE RAW MATERIAL
According to the last data collected by FAO in 2010, cork production amounts to 201 thousand tons, from which Portugal produces around 100 thousand tons (49.6%) followed by Spain with 61.500 tons (30,5%).
Average cork production in Portugal’s most productive montados is around 200-250kg per hectare, each tree yielding 40 to 60kg per harvest. Of this amount, 50% is used for the production of cork stoppers, while the remainder is used for other products. Each ton of cork is enough to make over 65 thousand stoppers.
An arroba (15kg) of cork can cost up to 30 euros, depending on its quality.