MOISTURE MIGRATION DURING A TEMPERING TIME AFTER THE HEAT TREATMENT STEP IN YERBA MATÉ PROCESSING

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Abstract - The aim of this research was to study the effect of applying a tempering time to the branches of yerba maté after the heat treatment stage (or sapecado). Assays were carried out in three industrial producers of Misiones Argentina. Branches were obtained from the sapecador outlet and then, they were put in rest in order to form a bed. First, moisture content of leaves and twigs, separately, and then losses of mass of whole branches were measured. When the branches were put in rest in a bed during 30 min, 8.60 kg of water/100 kg of dry matter were transferred from the twigs to the leaves and 5.17 kg of water/100 kg of dry matter were lost by evaporation.

Key words- yerba maté, tempering, moisture, migration.

I. INTRODUCTION

Yerba maté (Ilex paraguarienses Saint Hilaire) processing consists of four stages called sapecado, drying, grinding and seasoning. Generally, the first three stages are carried out in industrial factories located near the plantation.

When the branches are collected, they are cut by hand and quickly carried in order to be processed. At the reception, a wide variation in weights and forms of branches can be observed. These variations are in weight (between 5 and 100 g), shape (with or without sub-ramifications) and length (between 30 and 60 cm) (Crotti et al., 2002). Once received, they are put in a yard and they are introduced into the sapecador.

In the sapecado stage, enzymes producing browning in leaves are inactivated. The equipment consists of a cylinder that rotates at low revolution (about 10 rpm). Branches are fed in the extreme where the wood is burning. They pass through the flame between 1 and 3 times, receiving heat by radiation and convection. According to this, different branches can receive different heat treatments and loss different quantities of water. After that, the burning gases and the branches move to the output extreme in a parallel flux. Temperature of the air in the inlet extreme reaches about 350-400°C, while at the outlet extreme it is above 100°C (Peralta and Schmalko, 2007).

Initial moisture content of leaves and twigs are very similar (about 60%, wet basis), but at the outlet of the sapecador, the differences are high. In leaves, mean value is about 20% (wb) and in twigs, about 55% (wb) (Schmalko and Alzamora, 2001). Ratio between surface area/weight in leaves is 3 or more times greater than twigs. So, heat and mass transfer in leaves is greater than twigs and that is why losses of water are higher in leaves. Moreover, water diffusion coefficient in leaves are higher than in twigs (Schmalko et al., 1996).

Alfalfa is dried as whole branches in rotary dryers, similar to yerba maté. A similar moisture gradient is generated between the stems and leaves (Arinze et al., 2003; Arinze et al., 2007; Moore and Cilanski, 1992; Patil et al., 1992). In order to avoid excess in drying, the dried leaves are separated from the stems by dragging forces in order to have a minor residence time. Consequently, the dryer efficiency becomes higher as the solid flux is increased.

A similar technology could be applied to yerba maté processing. But these changes would modify the types of dryers used now by the industrial producers. These changes could be very expensive. So, other alternatives should be studied.

Intermittent drying (drying with tempering times) is applied to some foods in order to redistribute their internal moisture gradient. An improvement of product quality and energy saves is obtained. It has been used in rice drying (Li et al., 2003; Mabamba and Yabés, 2005; Nishiyama et al., 2006; Shi and Chen, 2002). In this material, when the intermittent drying is applied, cracking of the grain is avoided, because internal moisture gradient is reduced and energy efficiency is erased because time of heat applying is reduced, too.

The aim of this research was to study the effect on moisture content of applying a tempering time to the branches after the sapecado stage. If an appropriate moisture distribution is obtained, energy saves could be obtained in the drying stage.

II. MATERIAL AND METHODS

A. Material

Branches of yerba maté (Ilex paraguarienses Saint Hilaire) were used as test material. They were obtained at the outlet of the sapecador. Measures were made in three industrial factories between April and August/2008.

B. Methods

Four series of measurements were made:

1. Study of moisture migration in different branches:

Branches of different shapes and sizes were used. They were put into an isolated container in order to form a bed. One branch was taken after a certain