

THE LOSS OF MOISTURE AND THE DRY MASS OF *ANDRICUS HUNGARICUS* HTG. (*HYMENOPTERA: CYNIPIDAE*) GALLS

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Abstract: Galls of *Andricus hungaricus* Htg, forming on *Quercus robur* L, together with *Andricus quercuscalicis* Burg galls, were used for many years in Romania in tannery. Austrian-Hungarian Empire, at the end of XIXth century, exported these galls and the forestry industry substantially profited financially. Because of the high level of tannin, compared with other natural plant or product components, galls were used to tan the thickest oxen hide parts utilized for shoe making. It was discovered that gall tanneries used galls up the year 2000 in the Pancota area of Arad County, Romania. The galls used to be collected by locals, and sold to tanners in places like Pancota, Arad County. After that, the galls used to be dried out in the attics of their own houses and a local stone mill was used to grind the galls and obtain flour used in tannery. The goal of the paper is to determine, by scientific methods, the period of time that is needed for the galls to dry out, to constant mass, and also to establish the dry mass of the *Andricus hungaricus* Htg galls. In order to do that, 303 galls were randomly collected from Lunca Muresului Natural Park, Arad County, Romania. All the galls were brought to the lab and were cleaned up using a plastic brush. The mass of each gall was measured every two days, using a precision balance. The measurements were stopped when the mass of the galls was constant from one determination to another, on constant lab temperature conditions (19°C). The galls were split into 10 classes and the decline curve of the humidity was established for each class. Five galls from each class were put into lab drying oven and the dry mass was obtained, by measuring the mass of each gall every 6 hours, to constant mass. The equation that establishes the dry mass from the "green mass" was determined. The research could have a practical use in case of collecting the galls for different economical use or research (besides tannery, the galls were/are used for ink production, pharmaceutical industry and others).

Key words: galls, *Andricus hungaricus*, dry mass, *Quercus robur*, tannery

INTRODUCTION

Andricus hungaricus gall that forms on oak is one of the most curious galls in Romania. It represents an interesting parasitic relationship between the wasp from *Cynipidae* Family, *Andricus hungaricus* and the host plant (*Quercus robur*). Studying this formation could bring valuable information about the forest ecosystem and its biodiversity, but also these galls, together with other ones were used in economy for different purposes.

The most important use of galls was in tannery, because of its high level of tannin (27-35% of mass). For example, in town of Pancota, Arad County, galls were used in leather processing until the year 2000. The villagers around Ineu city use to collect *Andricus quercuscalicis* galls, which in that area were called „cobii” and, with carts, took them to Pancota (about 20 km). They sold the galls to tanners with a price equivalent to corn price. The galls were then dried in the attic and ground into a powder utilizing a stone-grinding mill process. The flour obtained was put in water, boiled, and mixed with the animal hides. The tanned animal hides were used especially in the making of shoes, specifically the shoe soles.

Galls were not used only in Romania. For example, in 1861, England imported over 800 tons of *Cynips gallaetinctoriae* gall (today *Andricus gallaetinctoriae*) from Turkey for commercial purposes, especially for medicinal purposes. The United States have only been

importing galls from Turkey since 1945. Ink obtained from European oak galls was used for centuries. Monks have been using this ink for translations and municipal documentation for the past 1000 years. In more recent history the 1945 treaty with Japan, ending WWII was signed with oak gall ink (R. Russo, 2007). G. Csoka (Gubacsok, 1997) states that the exportation of *Andricus hungaricus* and *Andricus quercuscalicis* galls generated significant revenue for the Austrian-Hungarian Empire in the late 19th century.

This paper is related with the dry mass of the galls and the time needed for them to get dry to constant mass.

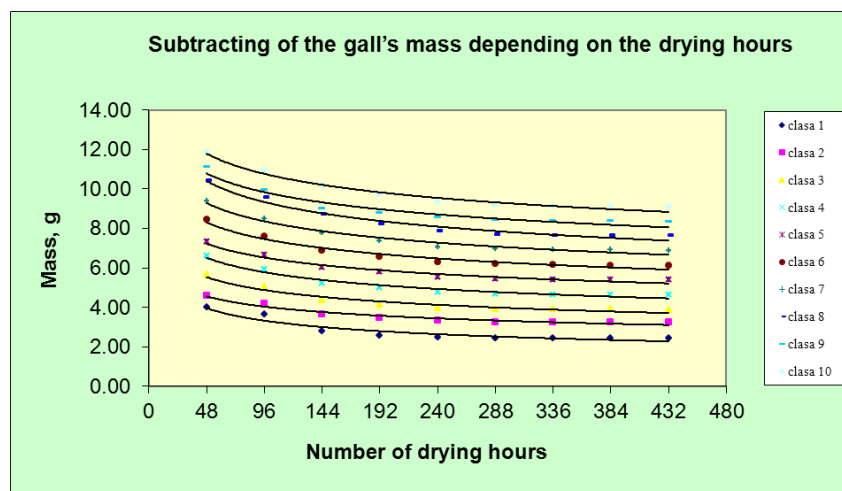
MATERIAL AND METHODS

The sample contains 303 galls collected from Lunca Muresului Natural Park, near Arad City, Romania. The samples were collected in November from the ground in the forest. They were collected randomly. After the sample was collected, it was left to acclimate to room temperature in the laboratory for two days, so that any residual vegetation or debris could be easily removed from the galls. They were cleaned up using a soft plastic brush. The mass of each gall was measured every two days, using a precision balance, ADAM AAA 250LE. The measurements were stopped when the mass of the galls was constant from one determination to another, on constant lab temperature conditions (19°C). The galls were split into 10 classes and the decline curve of the humidity was established for each class. Five galls from each class were put into lab drying oven, BINDER, at $103 \pm 2^\circ\text{C}$, and the dry mass was obtained, by measuring the mass of each gall every 6 hours, to constant mass. The equation that establishes the dry mass from the “green mass” was determined.

RESULTS AND DISCUSSIONS

LOSS OF MOISTURE

According to Figure 1 below, the galls of *Andricus hungaricus* Htg. (*Hymenoptera: Cynipidae*) needed 18 days (432 hours) to get dry to constant mass. These results were obtained in the lab conditions, on constant temperature (19°C). The drying process in the tanner’s attics could vary, of course, depending on the temperature, humidity into the atmosphere and the thickness of the gall’s layer. They needed dry galls to be able to grind them with the wheel mill. The ten lines in the figure represent the ten mass classes that the sample was divided.



DRY MASS AND MOISTURE OF THE GALLS

According to Table 1, the dry mass of the galls of *Andricus hungaricus* is 4.9 g/piece, in average. Taking a closer look, a quite big difference between the first mass class (1.97 g/piece, in average) and the 7th mass class (7.99 g/piece, in average) can be seen. This means that small and light galls can be found in the forest, but also bigger and heavier galls could be found. Regarding the moisture of the galls, the formula bellow was used:

$$U = \frac{Mi - Md}{Md} \times 100(\%), \text{ Mi=initial mass of the galls; Md=dry mass of the galls (1)}$$

It was used a dry mass ratio and not a “green mass” ratio because the first one is a constant one, but the initial mass of the galls in the forest may differ due to many factors. According to Table 1, the moisture of the galls is 63.29%, in average, on dry mass ratio.

Table 1

Dry mass and moisture of the *Andricus hungaricus* galls

Mass classes	Initial mass, g	Dry mass, g	Moisture, %
class 1	4.02	1.97	104.58
class 2	4.60	2.82	63.38
class 3	5.67	3.39	67.18
class 4	6.62	4.03	64.40
class 5	7.32	4.68	56.56
class 6	8.44	5.30	59.28
class 7	9.39	5.97	57.20
class 8	10.44	6.58	58.56
class 9	11.08	7.21	53.63
class 10	11.84	7.99	48.14
Average	7.94	4.90	63.29

CONCLUSIONS

Andricus hungaricus galls, together with *Andricus quercuscalicis* galls were used in tannery for a long period of time. Other galls had different economical purposes, like pharmacy, ink production and others. Local people in Pancota, Arad County used the galls that are subject of this work, *Andricus hungaricus* galls, for tannery until 2000. They used to buy galls from the locals near Ineu town. After buying them, the tanners used to dry the galls in the

attics of their own houses until constant mass and then to grind them. Through this paper, it was demonstrated that the galls need 18 days (432 hours) to get dry to constant mass in lab conditions (constant 19°C). It was also demonstrated that the dry mass of the *Andricus hungaricus* galls is 4.9g/piece, in average. The moisture of the galls is 63.29%, in average, on dry mass ratio.

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