Bulletin UASVM Agriculture 69(1)/2012
Print ISSN 1843-5246; Electronic ISSN 1843-5386

Research Regarding Barley Germination with the Jacobsen Machine Used for Obtaining Green Malt

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Abstract: Green malt is a semiindustrialized product obtained from barley and it represents a natural product, rich in enzymes and vitamins. In this paper were conducted laboratory researches to determine the optimum working regime for obtaining malt from barley. The research was conducted in the laboratory, which is equipped with a Jacobsen germination machine, which helped in projecting and realizing different work methods in obtaining green malt. In the experiments performed were considered different working conditions for germination of barley, such as measurement and monitoring of time, water level and water temperature in the tank for soaking and germination of barley. Thus, barley germination humidity ranged from 14% to 52% and temperature of 14^{o} C to 25^{o} C, which allowed the establishment of working diagram families, and under their influence were obtained different times for germination of barley. Barley varieties used in these experiments were Andreea and Mădălin which were grown on an agricultural land in the county of Iasi, area of Trifeşti and the Mădălin variety cultivated in the area of Peceneaga, Tulcea country. Following the experiences made with this machine was able to increase and to decrease willingly the speed of barley germination. By altering the speed of germination of barley were obtained several types of malt, which differ depending on the content of enzymes, fermentable sugar content, protein content and gums.

Keywords: barley, malt, germination, germination rate, Jacobsen, germination speed.

INTRODUCTION

Although at first glance barley is presented as a simple cereal that in ancient times was used as animal feed, but by certain events or transactions carried out deliberately by certain rules, barley proved to be good for human consumption. This could be done from the beginning by putting the barley to sprout in wood or clay recipients, resulting in a more or less uniformly germinated barley, which was used for human consumption and even observing that it has healing properties. By pressing the germinated barley green beans was obtained an off-white turbid liquid slightly sweet, which through practical tests was mixed with wheat flour and by baking this mixture were obtained tasty and healthy cakes. Over time the methods used for germinating barley were numerous and vary in their methods of use*(Dabija Adriana, 2001*).

By developing technologies for barley germination, the use of barley has grown considerably especially for obtaining malt that is mainly used to manufacture various types of beer. Tests on barley before and after germination have revealed significant changes in composition of barley grain in terms of organoleptic, physico-chemical and biological aspects. These changes proved to be beneficial because new substances created by physicochemical transfomations (see transformations of starch from barley to simple fermentable sugars), biological changes that facilitate the development of the embryo and roots, are rich in vitamins B, in creating enzymatic equipment and flavor substances. At this time there are many technologies for obtaining malts that can be used both in the brewing industry and in the bakery industry. Malt manufacturing technologies differ from one manufacturer to another

depending primarily on the market demand, on the quality of water used during soaking and germination of barley, the quality of raw materials and especially the type of industry in which malt will be used (in brewing or baking industry). Starting from the idea that it is possible to control the speed of germination of cereals, we sought and identified in the laboratory the Jacobsen germination table that, when we analyzed its characteristics, we concluded that it can be used to obtain green malt. We conducted several experiments and laboratory research to determine the optimum working regime for obtaining green barley malt.

MATERIALS AND METHODS

Equipment used:

Electronic scale: for weighing raw materials.
Humidity meter: to determine moisture of the grain cereals before and after germination.
pH meter: to determine the pH of green malt extract.
Oven: to determine the dry matter of products subject to drying.
Refractometer: to determine the Brix index (the percentage of sucrose/water).
Thermometer: to determine the temperature inside the layer of barley during germination.
Galvanized vessel equipped with an overflow which has smooth softening role.
Cylindrical boxes with galvanized mesh bottom in which barley is placed in layers of 3 cm.
Jacobsen germinator (figure 1): used to determine the germination of barley samples. The device consists of a stainless steel tank with dimensions of 60/120 cm which is mounted on a stainless steel frame closed on both sides with stainless steel sheets. The bottom of the tank is isolated with a special material (isoprene) and above it has some support bars for supporting trays which have holes with a diameter of about 6 cm. On these trays above the holes rest some plexiglas disks with a diameter of 7.0 cm. On these disks there are placed blotting papers to absorb the water that will reach the paper disks on which are placed the barley grains for germination (figure 1, 2). With the same Jacobsen germinator took place the germination of barley in its water tank, in which were placed the cylindrical boxes with galvanized mesh in which the barley was placed in layers of 3 cm.

The water temperature parameters, the water level and soaking times were checked with the water conditioning installations provided by the Jacobsen machine. The humidity was controlled with an external humidity meter.

Fig.1 The Jacobsen Germination Table

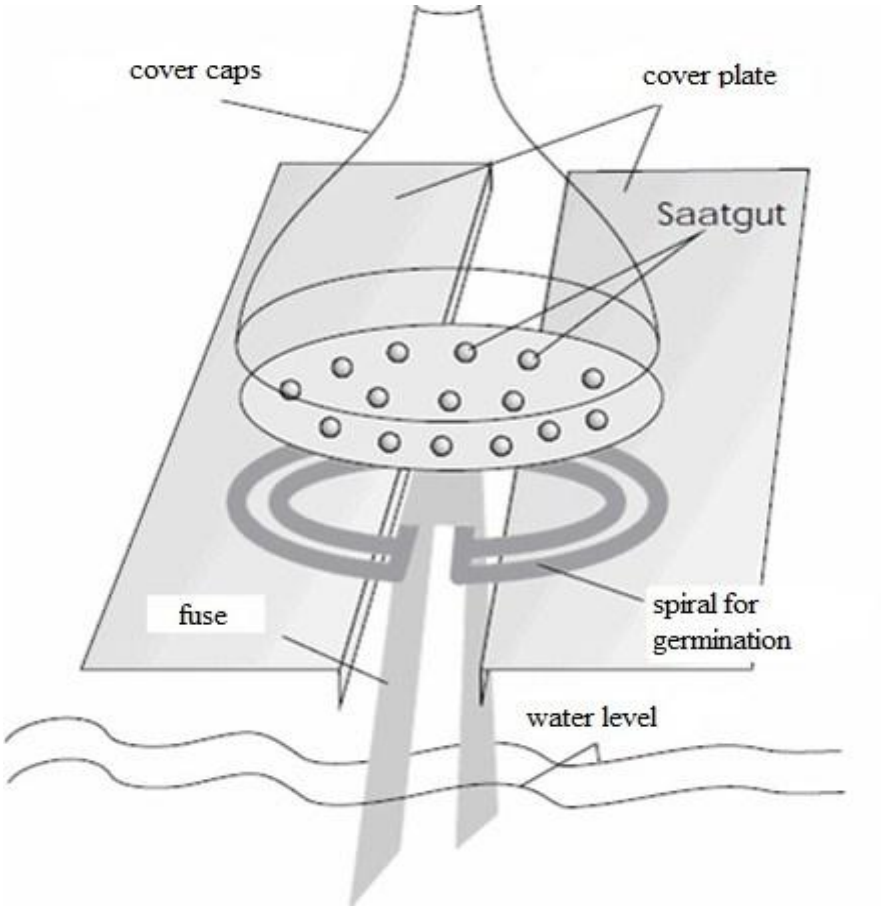


Fig 2: Placement components of barley samples

Raw materials: Barley (varieties: Mădălin and Andreea). Before starting the experiments, the barley must be analyzed and the results must fall within certain limits according to Table 1.

Tab. 1

Chemical composition of barley grain
(Diaconescu Maria și Theiss F, 2004)

Component name	Average content of dry matter %
Starch	63 - 65
Other polysaccharides (cellulose, gums, hemicellulose, pectin)	10 - 14
Simple sugars (sucrose, raffinose, maltose, fructose, glucose)	4 - 7
Protein (gluteline, prolamins, globulins, albumin)	9 – 11
Lipids	2 - 3
Minerals	2 – 2,4
Hydrolysable polyphenols and condensable polyphenols (anthocyanins, catechins, flavones)	0,1 – 0,3

The samples of barley that were experimented on have the following characteristics as seen in table 2.

Tab. 2

Barley analysis

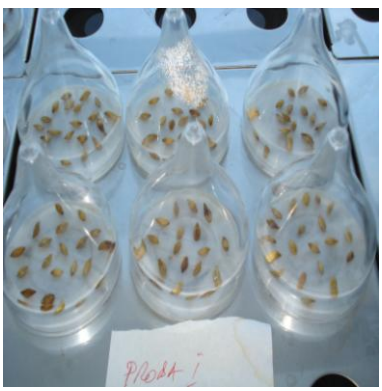
	CHARACTERISTICS	Andreea Barley	Mădălin Barley
1	Hectoliter weight	63,5	65,8
2	Foreign bodies in the sieve	0,2%	0,1%
3	Organic foreign bodies	0,4%	0,3%
4	Damaged, broken seeds	1,5%	1,1%
5	Defects barren seeds	0,6%	0,5%
6	Undeveloped seeds	0,3%	0.2%
7	Humidity	10,8%	12%
8	Uniformity	88,5%	95%
9	Aspect	Normal	Normal
10	Color	Specific	Specific
11	Smell	Pleasant	Pleasant
12	Taste	Normal	Normal

Following the laboratory tests performed on the 2 samples of barley we decided to perform germination tests with the Jacobsen germination table for two varieties of barley (figure 3a, 3b), as seen in table no. 3.

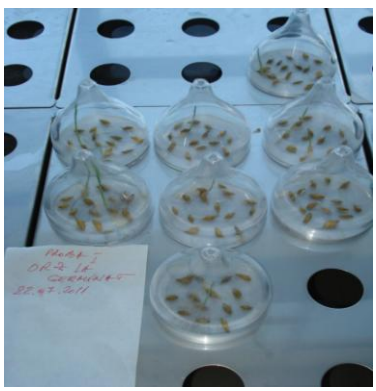
Tab. 3

Determining the percentage of seeds germinated

	Date	Andreea Barley				Mădălin Barley			
		Temp (^oC) Set	Time	Germinated barley under the influnce of light 12 h/day	Germinated barley without the presence of light during the germination period	Temp (^oC)	Time	Germinated barley under the influnce of light 12 h/day	Germinated barley without the presence of light during the germination period
1	30.09	20^{o}C	9^{00}	0	0	20^{o}C	9^{00}	0	0
2	01.10	20^{o}C	9^{00}	12%	20%	20^{o}C	9^{00}	5%	6%
3	02.10	20^{o}C	9^{00}	32%	37%	20^{o}C	9^{00}	45%	36%
4	03.10	20^{o}C	9^{00}	52%	51%	20^{o}C	9^{00}	65%	60%
5	04.10	20^{o}C	9^{00}	65%	72%	20^{o}C	9^{00}	79%	72%
6	05.10	20^{o}C	9^{00}	71%	78%	20^{o}C	9^{00}	92%	89%
7	06.10	20^{o}C	9^{00}	82	80%	20^{o}C	9^{00}	97%	95%



a



b

Fig 3: a – Germination of Andreea variety; b – Germination of Madalin variety

Obtaining Green Malt – Laboratory Technology

Reception fo raw material: the reception of raw materials takes place by quality and by quantity. Barley is received in terms of quality (considering sensory and physico-chemical) and quantitative (using an electronic scale to weigh samples that will be malted barley in the laboratory).

Conditioning of raw materials: barley has already been cleaned and sorted at the supplier. Also it was purchased from suppliers after the resting time of germination.

Cleaning and disinfection: in this case, barley was only washed in a galvanized container which is has an overflow through which are eliminated waters with light impurities.

The bottom of the container is provided with a tap and with its help the dirty waters were eliminated. From the washing container barley was transported with the help of the waters that facilitate the hydraulic transporter into the cylindrical boxes with galvanized mesh bottom, where it is placed in layers of 3 cm. The boxes filled with barley were then added inside the tank of the Jacobsen germination table, and they were filled with water until the layers of barley were entirely submerged. This operation took place in 72 minutes.

From this moment on began the soaking / germination process.

Soaking / barley germination (figure 4)**:** The germination took place in the Jacobsen germination machine following the germination diagrams previously established and then changed some germination parameters such as: break times during barley germination in the presence or absence of water, water temperature.

Operation of soaking / germination was halted when the size of the roots reached 16 mm and 3mm in stem.

Fig. 4 Soaking / barley germination

RESULTS AND DISCUSSIONS

This paper is structured in two stages. **In the first stage** took place experiments for the determination of the seed germination percentage regarding the 2 varieties of barley. In table no. 3 it can be seen that the percentage of germinated seeds of the Andreea variety got up to 95% in its first 5 days, and in the 7^{th} day the percentage grew to 97%.

The percentage of germination for the Mădălin variety grew to 85% in the first 5 days and to 92% in the 7^{th} day.

In both cases it can be seen that the germination process that took place under the influence of light, alternatively, it was more efficient, than the germination process that didn't take place under the light influence.

During the germination process the temperature of the paper disks used for determining the grain percentage was maintained between 22^{o}C and 26^{o}C.

In the second stage took place the effective technological process in obtaining green malt following a specific germination diagram with two varieties of barley. The purpose of the second stage was that to observe the growth speed of the roots of the barley grains until they reached 20 mm in size.

In table no. 4 we can see that we have achieved up to 18 mm size in roots, almost 2 times the size of a grain of barley, and the stem size was of 3mm which did not exceed 1/3 of the size of a grain of barley. These two parameters show a similar result in obtaining green malt by soaking it for 2-3 days and 5-7 days of germination.

Tab. 4

Germination diagram at a constant temperature of 24^{o}C

	Barley							
	Mădălin (Humidity = 12%)				**Andreea (Humidity = 13,2%)**			
	Sample weight (g)	**Degree of water absorption (%)**	**Soaking/ germination time (h)**	**Root size (mm)**	**Sample weight (g)**	**Degree of water absorption (%)**	**Soaking/ germination time (h)**	**Root/ plumule size (mm)**
1	300	-	-	-	300	-	-	-
2	388	29,33	12 hours w/ water	-	394	31,33	12 hours w/ water	-
3	341	13,67	12 hours w/o water	-	348	16	12 hours w/o water	-
4	412	37,33	12 hours w/ water	0,5/0	418	39,33	12 hours w/ water	0,5/0
5	382	27,33	12 hours w/o water	1,5/0	389	29,67	12 hours w/o water	1,5/0
6	432	44	6 hours w/ water	2/0	438	46	6 hours w/ water	2/0
7	394	31,33	12 hours w/o water	5/0	402	34	12 hours w/o water	5,5/0
8	442	47,33	4 hours w/ water	5,5/0	448	49,33	4 hours w/ water	6/0
9	406	35,33	12 hours w/o water	8,5/1	412	37,33	12 hours w/o water	9/0
10	452	50,67	2 hours w/ water	9,5/1,5	456	52	2 hours w/ water	10/0
11	412	37,33	10 hours w/o water	12/2	416	38,67	10 hours w/o water	14/0
12	438	46	2 hours w/ water	13/2	442	47,33	2 hours w/ water	15/1
13	422	40,07	4 hours w/o water	16/3	428	42,67	4 hours w/o water	18/2

The particularity of these experiments with the Jacobsen germination table was that barley germination operation took place after a common germination diagram. Basically barley germination was at certain periods of time under water (as the soaking operation) and some similar operation periods without water (dry soaking). Through this experiment the soaking time was shortened from 7 to 4 days and a half, in which time we managed to obtain green malt with characteristics similar to the green malt obtained in minimum 7 days.

These results encourage further research in the field to find new solutions on shortening processes for obtaining various types of land.

The barley seed germination experiment took place with the Jacobsen germination machine.

After having established the varieties of barley with the best germination properties the actual operation of obtaining green malt took place with the same Jacobsen germination machine.

CONCLUSIONS

The particularity of these experiments with the Jacobsen germination table was that the operation of germination of barley held by the same soaking diagrams. Basically, during the germination process, barley was at certain periods of time submerged (as the soaking operation) and some periods without water, similar to the operation of soaking dry. This is represented in the table. 2 that shows the underwater germination times and the ones without water.

ACKNOWLEDGMENTS

We thank you to the Department of Agricultural Mechanization and POSDRU 77222 Project

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