

RESEARCH ON MALT DRYING AT LOW TEMPERATURES TO PRESERVE VITAMINS

CERECETĂRI PRIVIND USCAREA MALȚULUI VERDE LA TEMPERATURI JOASE ÎN VEDEREA CONSERVĂRII VITAMINELOR

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Abstract. It is known for hundreds of years as the malt is a made from barley, and is a natural product, rich in enzymes and vitamins. Experimental researches were done using a germination Jacobsen plant and a dryer, for various conditions. The main goal of this work was the maintenance and conservation the vitamins in malt by drying at low temperatures in order to use human nutrition in a wide range of products. Green malt layer was 5 cm and initial moisture content at 46,1%. Main parameters follow the humidity and temperature were working both germination and drying (Stroia I., 1998). Maximum drying temperature was 60 °C. Following more charts for germination and drying, it was succeeded to obtain a malt with a moisture content of not more than 10% that preserve vitamins.

Keywords: malt, germination, moisture, vitamins, conservation.

Rezumat. Se știe de sute de ani în urma că malțul este un semifabricat obținut din orz, și reprezintă un produs natural bogat în enzime și vitamine. Cercetările experimentale au fost facute cu ajutorul mesei de germinare Jacobsen și o instalație de uscare, pentru diferite condiții de lucru. Scopul principal în cadrul acestei lucrări a fost conservarea vitaminelor în malț în urma uscării la temperaturi joase în vederea folosirii în alimentația omului într-o gamă largă de produse. Stratul de malț verde a fost de 5cm și umiditatea inițială de 46,1%. Parametrii principali urmăriți au fost umiditatea și temperatura de lucru atât la germinare cât și la uscare. Temperatura maximă de uscare a fost de 60 grade C. Urmând mai multe diagrame atât pentru germinare cât și pentru uscare dinainte stabilite s-a reușit obținerea unui malț cu umiditate de maxim 10% care îi asigură conservarea vitaminelor.

Cuvinte cheie: malț, germinare, umiditate, uscător, vitamine, conservare.

INTRODUCTION

Of the many old and new springs on the use of various products from barley we stopped at two sources: the book "1000 years of Beer existence in Austria" (Trumler, 1996) and the German Purity Law (Kunze, 1996) existing since 500 years ago, which clearly says that „beer ingredients must only be water, barley and hops”. These two sources show that barley has not been used as such, but was made to yield sprouting germinated barley, which was then dried and named malt (Stroia, 1998). The main technological stages to obtain malt are barley reception, cleaning and sanitizing barley, soaking and germinating barley (green

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malt), drying green malt, resulting dry malt (Diaconescu and Theiss, 2004). In the experiments we followed technological stages but soaking/sprouting and drying diagrams was made at different parameters than those used.

MATERIAL AND METHOD

Materials (used equipment)

- Moisture analyzer series MAC determining grain moisture before germination, while germination and during drying malt (*Fig. 3*); pH meter: pH determining green malt extract; thermocouple Thermometer: For determining the temperature inside the layer of barley during the germination process and the drying process; galvanized vase 5 liters fitted with an overflow which acts gently soaking in miniature. KERN electronic scale 440-49N with 0.1 g accuracy: for weighing raw material; Heat balance
- Cylindrical cassettes (diameter 24 cm and height 10 cm) bottom of galvanized mesh that put barley in layers of 5 cm (*Fig. 2*).
- Jacobsen table in which the zinc cassettes were added containin barley (*Fig. 1*). Parameters of the water temperature, water level and soaking times were controlled by air conditioning built into the Jacobsen table.

Experimental facility for drying green malt (vertical laboratory dryer - Figure 4, belonging to the Department of Agricultural Mechanization, University of Agricultural Sciences and Veterinary Medicine), was equipped with electronic digital display for controlling and monitoring the drying process parameters: drying agent temperature to 120°C, the speed of the drying agent up to 2.5 m/s and time.



Fig.1 - Jacobsen – germination plant



Fig. 2 - Cylindrical cassettes with barley



Fig. 3 - Heat balance



Fig.4 - Vertical dryer

Raw material: **Barley type Andreea**

Table 1

Analyzed barley characteristics

No.	FEATURES	Andreea Barley
1	Test weight	63,5 kg/hl
2	Foreign bodies in sieve	0,2%
3	Organic foreign bodies	0,4%
4	Seeds defects - smashed	1,5%
5	Seeds defects - cliffs	0,6%
6	Seeds defects undeveloped	0,3%
7	Moisture	13,2%
8	Uniformity	92,5%
9	Aspect	Normal
10	Color	Specifică
11	Smell	Plăcut
12	Taste	Normal
13	Germination speed	5 zile
14	Percentage of germinated seeds	97%

Method:

Drying. At the bottom of the dryer are located three resistors that heat the air making 1.5kW of heat and mass transfer by convection. The fan constituting dryer which is under resistors, draws air from the outside and then it goes back inside into the dryer from the bottom up. Dryer operation is discontinuous and follow these steps:

- Supply of green malt in a box with the bottom of the galvanized mesh distributed in layers of about 1 cm
- Inserting a cassette into the drying room;

- Sealed drying room, turning on the fan, electrical resistance switching and keeping dry green malt drying the diagram
- Cooling the dried malt;
Removal of the product.

The dryer is provided with: a thermostat, which controls the independent heating and the temperature is kept constant cu temperature sensors (which monitor the dryer inlet air temperature and the air temperature in the dryer grill); humidity sensors (intake air humidity in the dryer and the humidity of the air at the outlet of the dryer). According to a moisture control chart weight loss due to water removal products are tracked using electronic scales mounted above the drying chamber. Velocity is adjusted of the touch screen interface of the dryer by adjusting fan speed.

In laboratory tests with the device plus Merck 1.16980001 RQflex reflectometer, on several samples of malt in the laboratory of physicochemical analysis of the discipline of oenology at the farm Adamachi USAMV was able to determine the presence of vitamin C.

Material and method (recommended by the manufacturer Merck 1.16980001 plus RQflex Reflectometer) to determinate vitamin C.

Materials:

- Malt sample up to 50 g.
- 0.5% trichloroacetic acid solution in an amount of 50g
- PH 7 buffer solution in an amount of 0.8 ml
- 1,4-dithiothreitol aqueous solution (15.4 mg of 1,4-dithiothreitol dissolved in 1 ml of distilled water) in an amount of 0.1 ml
- Aqueous solution of N-ethylmaleimide (50 mg Nethylmaleimide dissolved in 1 ml of distilled water) in an amount of 0.1ml

Reagents:

Cat.No. 116981 Reflectoquant ® test ascorbic acid, Cat.No. 116 970 RQflex ® reflectometer, Cat.No. 116 955 Reflectometer RQflex ® plus, Cat.No. 109 439 pH 7 buffer solution, Cat.No. 111474 1,4-Dithiothreitol, Cat.No. 100 807 trichloroacetic acid, Cat.No. 34115 N-ethylmaleimide.

Preparation of samples: solid material (the sample of malt) ascorbic acid was extracted with trichloroacetic acid before the final determination of ascorbic acid. Add 50 g of a solution of trichloroacetic acid 0.5%, 50 g of malt and stirred in a glass vessel with ultrasound for 8 minutesIt is then filtered through a paper filter and it is analyzed only the liquid part. Adding 0.8 ml of pH 7 buffer solution and 0.1 ml of 1,4-dithiothreitol aqueous solution (15.4 mg 1,4-dithiothreitol dissolved in 1 ml distilled water) to 1 ml of sample (or filtered), mixed well and allowed to react for 15 minutes. Then add 0.1 ml aqueous solution of N-ethylmaleimide (50 mg Nethylmaleimide dissolved in 1 ml of distilled water) and stir again. This mixture (sample as solution) is analyzed with the reflectometer after 1 minute. Review: Press the START button and simultaneously test paper pretreated mixture is introduced into the sample solution (5-30 °C) for approximately two seconds, ensuring that the two areas are fully submerged the solution analyzed. Excess fluid from the long edge of the strip will be absorbed by blotting on an absorbent paper towel. Wait 15 seconds and then the test paper strip is inserted into the reflectometer slot. The result with the value [mg / l] total ascorbic acid it is automatically stored in the reflectometer's memory and it is displayed digitally. The recommended calculation by the equipment manufacturer is

as follows: Total content of ascorbic acid [mg/l] = the measured value and it is displayed on the reflectometer [mg/l] x 4. (Determination Method of vitamin C)

RESULTS AND DISCUSSIONS

The values results from analyzes are found in Table 2 for the drying operation, the and vitamin content of different types of malt in Table 3.

Table 2

Malt drying diagram

No	Date	Time	Speed (m/s)	Air temperature under grill (°C)	Product core temperature (°C)	Moisture (%)
1	4.04.13	16 ⁰⁰	1,5 m/s	40 ⁰ C	20 ⁰ C	46,10
2	4.04.13	17 ⁰⁰	1,5 m/s	40 ⁰ C	38 ⁰ C	40,91
3	4.04.13	18 ⁰⁰	1,5 m/s	42 ⁰ C	40 ⁰ C	36,12
4	4.04.13	19 ⁰⁰	1,5 m/s	45 ⁰ C	43 ⁰ C	31,42
5	4.04.13	19 ³⁰	1,5 m/s	50 ⁰ C	48 ⁰ C	26,23
6	4.04.13	20 ⁰⁰	1,5 m/s	55 ⁰ C	53,5 ⁰ C	20,58
7	4.04.13	21 ¹⁵	1,5 m/s	57 ⁰ C	56 ⁰ C	16,23
8	4.04.13	22 ¹⁵	1,5 m/s	58 ⁰ C	57 ⁰ C	13,64
9	4.04.13	23 ¹⁵	1,5 m/s	58 ⁰ C	57 ⁰ C	11,82
10	5.04.13	0 ⁰⁰	1,5 m/s	59 ⁰ C	58 ⁰ C	10,44
11	5.04.13	2 ⁰⁰	1,5m/s	60 ⁰ C	58 ⁰ C	9,04

Table 3

Results regarding malt's content of vitamin C in different stages of maturation

No.	Malt type	Fabrication date	Moisture (%)	Vitamin C content (mg/l)	Maximum drying temperature °C
1	Green malt	03.04.2013	44,34	96	22
2	Blond malt	02.02.2013	9,96	48	60 ⁰ C
3	Blond malt	04.04.2013	9,04	56	58 ⁰ C
4	Blond malt	24.04.2013	6,52	8,8	75 ⁰ C
5	Blond malt	29.04.2013	4,73	0	85 ⁰ C
6	Blond malt	28.09.2012	10,10	44	59 ⁰ C
7	Blond malt	08.10.2012	9.90	40	60 ⁰ C

Vitamin C content according moisture content of malt and drying temperature is represented in figure 5.

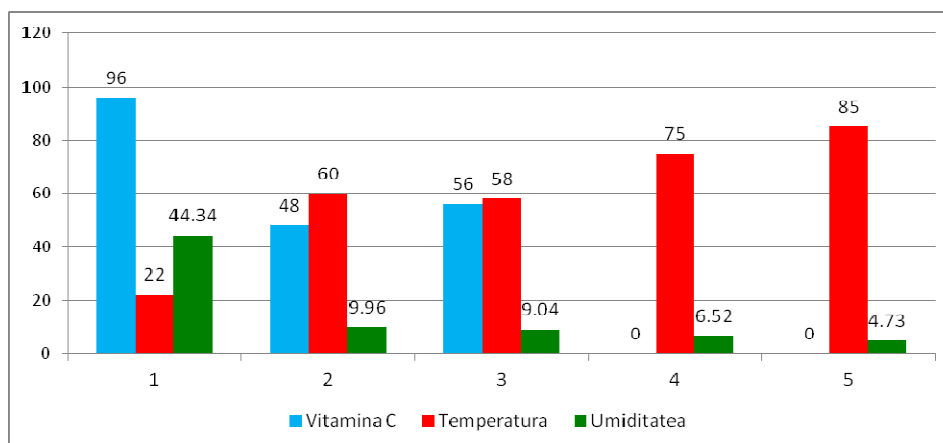


Fig. 5 - Vitamin C content according to the moisture of the product and drying temperature

CONCLUSIONS

1. Drying up to a temperature of 60 °C, β -amylase continues its activity and the exo- β -glucose reacts like β -amilose, the existing enzymatic equipment in barley grain and the one that appeared during germination remain in malt (Kunze W., 1996) , also a significant content of vitamin B complex remains present in malt (Diaconescu Maria Daniela, Theiss F., 2004).

2. After the obtained results it can be seen highest quantity of vitamin C contained by green malt, with a high water level at a temperature close to 22 °C. Until temperature reaches 59 °C an important quantity of vitamin C of 44,4mg/l is kept. When the temperature reaches 60 °C and the moisture level drops, can be observed a decrease of malt's quantity of vitamin C until it reaches 40mg/l.

3. It is pleasing that vitamin C was maintained in the old malt made weight months ago in the amount of 40 mg/l.

4. At temperatures over 85 °C vitamin C disappeared.

***Acknowledgments:** We like to thanks to the management of the Mechanization Department and also the management of UASVM University which shared the neccesary equipment thath we need to conduct the experiments.*

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