

## THE HOP ALPHA ACIDS CONTENT OF HOP CULTIVARS IN ROMANIA DURING 2012-2013

TOFANA Maria\*, Aca iu MORA\*\*, Sonia SOCACI\*, Liana  
SALANTA\*, Anca FARCAS\*, Maria Doini a BOR , Ana-Viorica  
POP\*, Melinda NAGY, Dana FEIER\*, Lumini a VÂRVA\*, Suzana-  
Elena BIRI -DORHOI\*, Cosmina BOG TEAN\*

\* University of Agricultural Sciences and Veterinary Medicine, Faculty of Agriculture,  
3-5 M n stur Street, 400372 Cluj-Napoca, Romania, tel. 0264596384,

[tofanam@yahoo.com](mailto:tofanam@yahoo.com)

\*\* S.C. MORAGROIND SRL, B-dul Delavrancea 1848, 50/6, Tg.-Mures, Romania.

**Abstract.** The determination of hop bitter acids in hop cones and pellets is very important for the brewing process because it is in close relationship with the bitter value of bier. In the Food Safety and Quality Laboratory (FSQL) of UASVM Cluj-Napoca the content of bitter acids is annually determined for the chemical evaluation of hop crop in Romania. This work present the content in alpha bitter acids of hop cones and pellets from five hop varieties, Hallertau Magnum (HM), Merkur (Mk), Brewers Gold (BG), Perle (P) and Huller Bitterer (HB), produced from hop farms located in Sighi oara aria. The analyses were determined on harvesting time, during the last two years (2012-2013).

**Key words:** *Humulus lupulus* L., hop pellets, hop varieties, hop bitter acids, - acids

### Introduction

*Humulus lupulus*, L. ssp. europeus Ryb. is the hop species whose female inflorescence, the cone as it is called, are used in beer production. There are bitter substances and volatile oil in the lupulin's glands of the hop cones,. The bitter substances give the bitter taste of the beer and the volatile oil contributes, together with other hop compounds, to the flavor of the beer. The study of these classes of compounds from the hop cones is very useful and very legitimate, from the point of view of content and composition.

The study of the biter substances and the volatile oil from the hop cones know more possible approaches for investigation:

- farmer's point of view
- food technologist's point of view

- pharmacological point of view

For the first approach, the main objectives are:

- Select the biological material by breeding (Muntean et al., 2002);
- Establish the optimum harvesting period;
- Amelioration and acclimatization of the hop germ plasma;

Food technologists are interested about following aspects:

- Quality determination of the hop cones and pellets, regarding to their content in the bitter acids and aroma of hop (Mudura et al., 2008);
- Identification of some criteria for varieties discrimination (Socaci, 2009; Socaci et al., 2009);
- Determination of the transformation of the interested compounds during storage (Tofan et al., 2006; Salan et al., 2011);

Pharmacological (Zanoli et al., 2008) hop investigations are related to:

- Identification and characterization of the hop cones antioxidant (Mudura et al., 2010), antimicrobial (Johnson et al., 2001; Shapouri et al., 2011) and hormonal (Magalhaes et al., 2009; Zava et al., 1998) activities;
- Elaborating new functional products and new ways for valorization of the hop bioactive compounds;

The researches regarding the hop bitter acids content in the hop cones and pellets, from the Romanian Hop Farms, were carried out in the Food Science Department, more precisely in the Food Safety and Quality Laboratory (FSQL) in UASMV Cluj-Napoca. These researches are integrated in the large area of hops biological active compounds investigation in close relation with the development of Agro-food Biotechnologies doctoral school belonging to Food Science and Technology Faculty from UASVM Cluj-Napoca. In this respect we had presented in the latest of our study (Tofana et al., 2012), the main direction of the hop research of our team in close relation with evaluation of hop and beer bitter and aroma compounds and monitoring the content in alpha acids of hop varieties grown in Romania.

The objectives of the present study are integrated in the last research direction, the assessment of alpha bitter acids content of several hop varieties grown in Romanian hop farms.

## Materials and methods

The content in alpha bitter acids of hop cones and pellets from five hop varieties, Hallertau Magnum(HM), Merkur(Mk), Brewers Gold(BG), Perle(P) and Huller Bitterer(HB), produced from hop farms located in Sighi oara aria, were determined, on harvesting time, during the last two years (2012-2013). All the samples were collected and packaged from the producers and sent for analysis in the FSQ L - Laboratory. The method used for hop bitter acids analysis, the Conductometric Value (CV), was the one described in Analytica EBC 7.5: Determination of conductometric value of hop, hop powders and hop pellets. The water content was determined according to SR 13842:2003 and Analytica EBC 7.2 methods.

Equipments used for analyses:

- Analytical balance, Shimadzu, model AX 120, series D440300121, IU-07
- Agitator GFL Germania, model 3005, series 10370205B, IU-11
- Automated titrator and conductometer, Schott, model TA 20 PLUS, series 99430098/0545, IU-08
- Oven, Memmert, model UNB 400, series C4051358, IU-03

The results are expressed as conductometric value (CV%) of hop cones and pellets, and are reported as such and as in dry weight. Also, the mean and standard deviation value of hop bitter acids for each hop variety and year were calculated.

## Results and discussion

In the Table 1 and figures 1-2 are presented the mean values obtained for bitter acids content (CV%) for the five hop cultivars taken into study, during 2012-2013.

For Hallertau Magnum variety the content in alpha bitter acids for both the cones and pellets was bigger in 2012 comparative with 2013 and varied between 16.99-15.69% for hop cones and between 13-11.77 for hop pellets. The bitter acids losses in pellets comparative with the same in cones (approx.3%) are due to the pelletisation process, namely the oxidative reactions at the high process temperature(Fig.1a).

The Merkur cultivar showed the lowest differences in the content in bitter acids for both years taken into study (13.14-12.9%) as well as for the sample type (cones and pellets). The losses in bitter acid content during the pelletization process were under 1%. Thus, it can be noticed that the Merkur

cultivar showed a good ecological plasticity, the differences between the two agricultural years being under 1% (figure 1.b).

The Brewers Gold cultivar has the highest amount of bitter acids compared with Magnum and Merkur cultivars. In the case of Brewers Gold cultivar, the bitter acid content is higher for the year 2013, for both cones (9.02%) and pellets (11.23%), compared with the values obtained for the year 2012 (7.71% - cones and 9.53% - pellets). The losses in bitter acids during the pelletization process are around 2% for the mentioned years, placing this cultivar between the Merkur and Magnum cultivars (Figure 1c).

The mean content in alpha acids for Perle cultivar varied between 8.45-11.4% for hop cones samples and between 8.45-8.88% for hop pellets samples. The pelletization process greatly influenced the content in bitter acids for year 2012 hop pellets samples, a difference of 2.52% was noticed between hop cones samples and hop pellets samples for this year (Fig.1.d).

Table 1

The protocols of analysis and the results

Variety	Year 2012						Year 2013					
	cons			pellets			cons			pellets		
	No. Pro be	CV % d.w.	±SD	No. Pro- be	CV % d.w.	±SD	No. Pro- be	CV % d.w.	±SD	No. Pro- be	CV % d.w.	±SD
<b>H M</b>	7	16.99	1.86	12	13	1.56	4	15.69	1.60	13	11.77	1.51
<b>Mk</b>	1	13.14	-	2	12.60	0.35	2	12.90	0.16	3	11.94	1.57
<b>BG</b>	3	9.53	1.30	4	7.71	2.56	3	11.23	0.60	4	9.02	1.33
<b>P</b>	3	11.40	2.23	6	8.88	1.70	3	8.62	1.60	8	8.45	0.82
<b>H B</b>	1	11.81	-	3	7.17	0.75	2	7.58	2.20	3	7.25	0.25
<b>Total</b>	15			27			14			31		

For Huller Bitterer variety, for all other hop cones samples, the highest values for bitter acids content were determined for year 2012 crop similar with the Perle hop cones and pellets for the same year. Although, it has to be mentioned that after pelletization process a similar comportment,

as for Perle cultivar, was observed, namely a significant decrease (4.64%) in alpha acids content was observed (from 11.81% in cones to 7.17 % in pellets)(Fig.1.e).

A comparative evolution of bitter acids content in pellets, for each hop cultivar taken into study during a two year period is presented in figure 6. It can be noticed that in 2012 the bitter cultivars Hallertau Magnum and Merkur contained slightly upper levels of bitter acids than in 2013, while the Brewers Gold cultivar presented lower values for 2012(Figure 2).

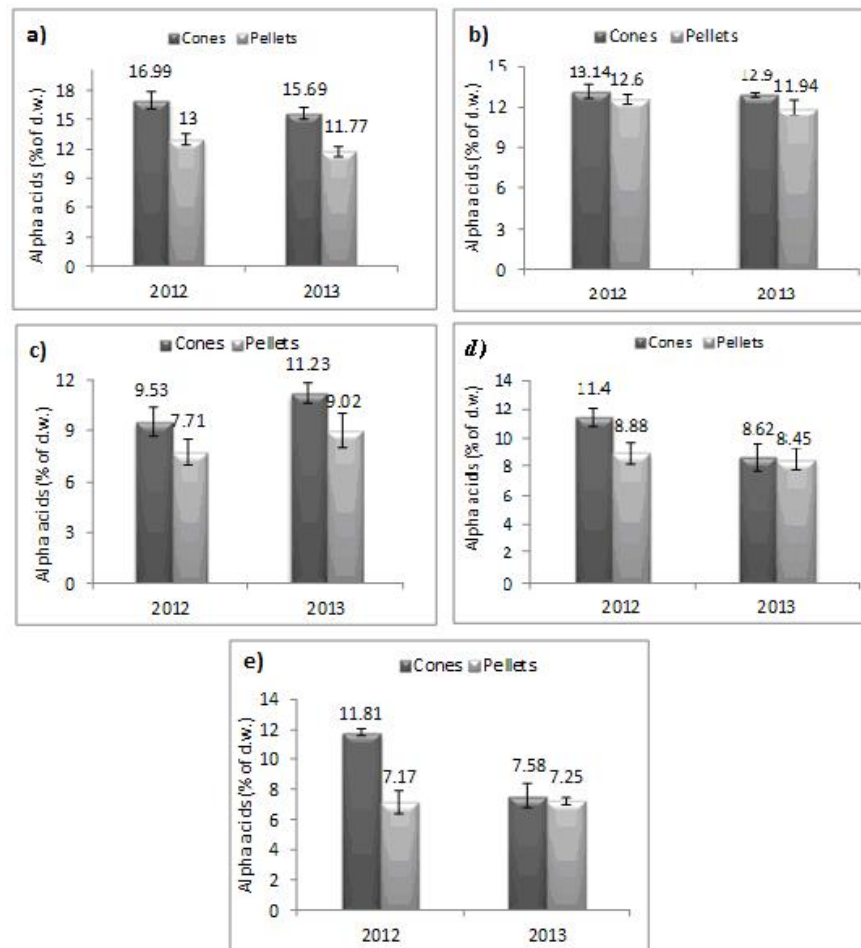


Figure 1 The mean content of alpha acids in cones and pellets (% of d.w.):  
a) Hallertau Magnum, b) Merkur, c) Brewers Gold, d) Perle e) Huller Bitterer

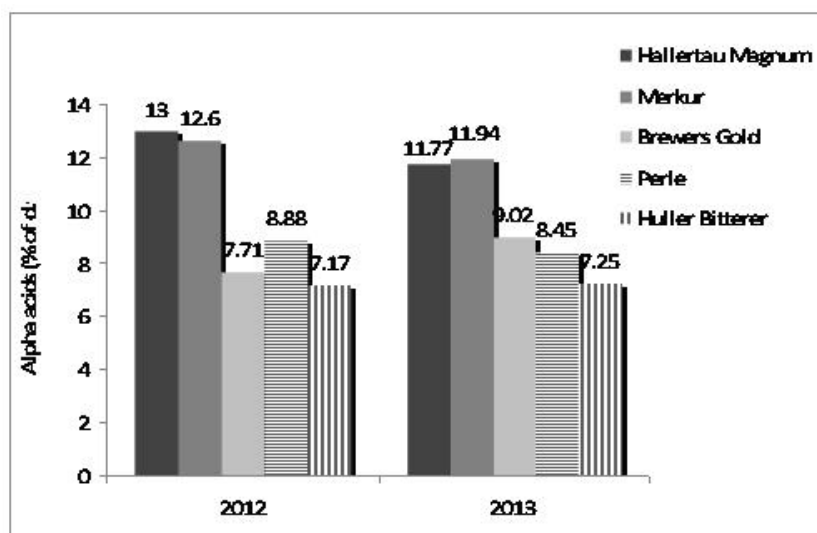


Figure 2. The mean content of the alpha acids in the different hop varieties pellets (% of d.w.)

### Conclusions

- The Hallertau Magnum and Merkur pellets have a similar behavior, showing slightly lower levels (~1%) for 2013 than for 2012
- The pellets of Brewers Gold cultivar had a different behavior compared with the other two bitter cultivars, namely lower levels of bitter acids in 2012 than in 2013 (~1%)
- The pellets of Perle and Huller Bitterer aroma cultivars had a similar pattern in the two studied years, standing out by a good plasticity
- For all the studied cultivars, the peletization process involved substantial losses in the content of bitter alpha acids (1-3%).

### References

1. Johnson Eric A., J. Gerhard Haas, 2001, Antimicrobial Activity Of Hops Extract Against *Clostridium Botulinum*, *Clostridium Difficile* And *Helicobacter Pylori*, Patent no. US 6,251,461 B1.
2. Magalhaes PJ, Carvalho DO, Cruz JM, Guido LF, Barros AA., 2009, Fundamentals and health benefits of xanthohumol, a natural product derived from hops and beer. *Nat Prod Commun.* ;4(5):591-610.

3. Mudura Elena , Sevastita Muste, Maria Tofana, Sonia A. Socaci, Veronica Goina, 2008, Improving The Hop Utilization In The Beer Biotechnology, *Bulletin UASVM, Agriculture* 65(2), pISSN 1843-5246; eISSN 1843-5386.
4. Mudura Elena, Maria Tofana, Adriana Paucean, Sonia Socaci, 2010, 'The evaluation of antioxidant capacity of Romanian hops', *Journal of Agroalimentary Processes and Technologies*, 2010, 16 (2), 262-264.
5. Muntean, L.S., S.Cernea, Al.Salontai, G.Morar, D.Vârban, L.Muntean, M.Duda, S.Muntean, Sevasti a Muste, Rodica Vârban, Maria Tofan , 2002, Culturi comparative cu clone de hamei create la USAMV Cluj-Napoca, *Hameiul i plantele medicinale*, Tipo Agronomia, an X, Nr.1-2(19-20), 57-69.
6. Salanta (Safta) Liana-Claudia, Maria Tofana, Sonia Ancuta Socaci, Rowena, Cheleman, Elena Mudura, Delia Truta, 2011, 'The Utilization of Conductometric Method for Determination of Quantitative Modifications of Hop Pellets Bitter Acids During the Storage', *Bulletin UASVM Agriculture*, Cluj-Napoca, 68(2), Print ISSN 1843-5246, Electronic ISSN 1843-5386, 549.
7. Shapouri R, Rahnema M., 2011, Evaluation of antimicrobial effect of hops extracts on intramacrophages *Brucella abortus* and *B. melitensis*, *Jundishapur J Microbiol.*; 4(Supplement 1): S51-S8.
8. Socaci Sonia A., Maria Tofan , Carmen Socaciu, Cristina Semeniuc, 2009, Study regarding the authenticity of some essential oils originating from plants cultivated in Romania, *Proccedings of the Second International Conference: Research people and actual tasks on multidisciplinary sciences*, Bulgaria, 1, 132-136.
9. Socaci, Ancu a Sonia, 2009, *Optimizarea sistemelor GC-MS pentru determinarea amprentei uleiurilor volatile din plante aromatice i medicinale*, Tez de doctorat, USAMV Cluj-Napoca.
10. Tofana Maria, Sevastita Muste, Sonia Spinean, Elena Mudura, Constanta Modoran, 2006, 'Researches Regarding The Quantitative Modifications Of Hop Pellets Bitter Acids During The Storage', *Buletin USAMV – CN*, 62, 365-370.
11. Tofan Maria, A.Mora, Sonia Socaci, Sevasti a Muste, Elena Mudura, Delia Michiu, Liana Salan , Anca F rca , 2012, *The content in alpha bitter acids of hop cultivars cultivated in Romania during 2008-2011*, Hop and medicinal plants nr. 1-2 (39-40), pag 23-28.

12. Zanolì P, Zavatti M., 2008, Pharmacognostic and pharmacological profile of *Humulus lupulus* L. *J Ethnopharmacol.*, 116(3):383-396.
13. Zava DT, Dollbaum CM, Blen M., 1998, Estrogen and progestin bioactivity of foods, herbs, and spices. *Proceedings of the Society for Experimental Biology and Medicine*, 217(3):369-378.
14. EBC- Method 7.2./Analytica- EBC, Section 7 Hops: Moisture Content of Hops and Hop Products.
15. SR 13842:2003, Determinarea umiditatii prin uscare in etuva.
16. Analytica EBC 7.5; 7.6, Determinarea valorii conductometrice a hameiului, pulberilor si peletilor.