

THE EFFECT OF LOCALITY ON THE GRAPE POMACE NUTRITIONAL VALUE FROM THE DIFFERENT LOCATIONS OF SLOVAKIA

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Abstract

*Nowadays, several experiments have shown that grape pomace has potential as a feed in animal nutrition and could be a good source of nutrient with beneficial antioxidant activity. Thus, the aim of the research was to compare the nutritional value of Pinot Blanc (*Vitis vinifera* sp.) pomace from two different localities of Slovakia (Vinohrady nad Váhom and Oponice). In the samples, the content of crude protein (CP), ether extract (EE), crude fibre (CF), ash (A), nitrogen-free extract (NFE), acid-detergent fibre (ADF), neutral-detergent fibre (NDF), lignin (L), cellulose (C) and hemicellulose (H) according to standard analytical methods were determined. After the evaluation of results, it can be concluded that between different locations of grape pomace, statistically significant results were found. The biggest and statistically significant differences in the case of CP (4.87%; $p < 0.05$), EE (16.37%; $p < 0.01$) were determined. However, larger differences in the case of ADF (41.56%; $p < 0.01$), NDF (49.99%; $p < 0.01$), L (8.88%; $p < 0.01$), C (428.85%; $p < 0.01$) and H (110.63%; $p < 0.01$) were found. The biggest ratio of organic matter was consisted from NFE in both localities. However, the ratio of EE and CP in the second locality was higher in comparison with the first locality.*

Keywords: nutrition, grape, by-products, analysis

1. INTRODUCTION

Increased efforts are now being directed towards a broader revaluation of polyphenol-rich residues from wine processing for obtaining high value by-products (grape pomace, seeds, skin and polyphenols). Samples reveal that the nutritional composition varies widely, depending on the variety of grape, the location and the conditions of fertilization (Brenes et al., 2016). The nutritive value of grape pomace depends also on the proportion of seeds and pulps (Guerrera-Rivas et al., 2016). Higher level of NDF fractions with high lignin and tannin content can be a major limiting factor of using grape pomace in diets for monogastric animals. Ivanišová et al. (2018) found high antioxidant activity in grape samples with high content of total polyphenols. However, studies carried out in vivo and in vitro over the last few years have shown the beneficial effects of administering these bioactive compounds because of their antioxidant and antimicrobial activity (Alonso et al., 2002, Torres et al., 2002, Viveros et al., 2011). Recent studies showed that grape pomace can be used in feed mixtures for poultry up to 6% without the performance and health deprivation (Brenes et al., 2008, Chamorro et al., 2013). Moreover, Chamorro et al. (2015) observed higher oxidation stability of poultry with higher content of PUFA. On the other hand, in the experiment of Liu et al. (2013), growth performance of poultry was improved. In experiments with pigs, feeding fermented grape pomace or grape marc meal improved nitrogen digestibility and growth performance, modified the pattern of fatty acids in subcutaneous fat (Yan and Kim, 2011), improved the gain to feed ratio (Fiesel et al., 2014) and reduced *E. coli* in faeces of weaned pigs (Verhelst et al., 2014). Because of its low cost and high fibre concentration, grape residue can be an alternative feed ingredient to replace partially the forage portion in the diet of ruminants (Makris et al., 2007). Eleonora et al. (2014) concluded that grape pomace is a good source of fibre and may be used in small quantities in ruminants to meet the requirements of energy and nitrogen. In dairy cows, addition of grape pomace was beneficial for normal blood parameters, that help to keep cows in good condition. Moreover, dairy cows fed with addition of grape pomace had milk constituents in normal levels (fat, protein, casein) (Chedea et al., 2016). The presence of linoleic and oleic acids in by-products of wine industry have also effect on the quality of meat and fatty acid profile of milk (Yi et al., 2009). Since, grape pomace addition in daily diets have beneficial effect on

the animal production and animal production quality and differs significantly on the locality, the aim of the study was to compare nutrients concentration of Pinot Blanc (*Vitis vinifera* sp.) pomace from two different localities of Slovakia (Vinohrady nad Váhom and Oponice).

2. MATERIALS AND METHODS

2.1. Materials

In overall, 8 dry grape pomace samples of Pinot blanc variety (*Vitis vinifera* sp.) from two different localities of Slovakia (Oponice and Vinohrady nad Váhom) were collected. After that, grape pomace characterised as a result of winemaking industry after juice pressing in Laboratory of Quality and Nutritive Value of Feeds at Department of Animal Nutrition, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra were analysed. Thus, grape pomace as a grape skin, seeds and bulbs was characterised as an analysed material.

2.2. Methods

Standard laboratory techniques were used to determine basic nutrients and fibre contents (AOAC, 2000). Samples were predried under 55 ± 5 °C for three days and milled by laboratory mill (Fritsch, GER) to pass 1 mm sieve. Residual Dry matter (DM) content has been determined gravimetrically at 105°C. Ash (A) was determined by resulting inorganic residue weight after ignition in Muffle furnace at 550°C, crude protein (CP) as total nitrogen content determined by the Kjeldahl method (Nx6.25). Ether extracts (EE) as crude fat was determined by extraction and gravimetric method according to the Soxhlet principle, without previous acid treatment. Crude fibre (CF) content was determined gravimetrically as the difference between residue after hydrolysis and after combustion. Neutral detergent fibre (NDF) content was determined in the Ankom 200 Fiber Analyzer (Ankom Technology, U.S.A.) according to procedures derived from Van Soest et al. (1991). Acid detergent fiber (ADF) after hydrolysis in acid detergent soluble of cetaltrimethylamoniumbromide and sulphuric acid determined by Fibertec System 1010 Heat Extractor (Tecator, Switzerland) and Dosi – Fiber (Selecta, Spain). Lignin (ADL) was determined as residue after hydrolysis of ADF sample by 72 % solution of sulphuric acid in laboratory temperature. Nitrogen free extracts (NFE), Organic matter (OM), Hemicellulose (H), Cellulose (C) were calculated.

2.2.1. Statistical analysis of results

Results were statistically evaluated with IBM SPSS v. 20.0. Descriptive statistics using One-way ANOVA were generated. Then, statistical significance of results were separated using Independent samples T-test.

3. RESULTS

In general, grape pomace DM content between the locations was similar and the difference between the samples was very small and nonsignificant. However, higher DM content (0.80%) in the case of Location 1 compared to location 2 was found (Table 1). Larger and statistically significant differences in the CP and EE concentrations were found. In the both samples lower CP concentrations by 4.87% ($p < 0.05$) and lower EE concentrations by 16.30% ($p < 0.05$) in Location 1 were observed. On the other side, content of CF was higher (by 1.73%) in Location 1 in comparison with Location 2. Moreover, higher concentrations of A by 1.68 %, also in Location 1 were observed. Lower concentration of CP and EE in Location 1 were substituted by higher content of NFE in Location 1 compared to location 2 by 3.07%. However, the content of OM in both locations was similar with difference only 0.07%. On the other side, the largest differences in the fibre complex between the locations were observed. Thus, in Location 1 significantly higher content of ADF in comparison with Location 2 by 41.56% ($p < 0.05$) was found. Moreover, the difference in NDF concentrations between the locations was larger. The NDF content in Location 1 was higher compared to Location 2 by 49.99% ($p < 0.05$). On the other hand, significantly lower content of L in Location 1 compared to Location 2 was determined (8.88%, $p < 0.05$). The greatest difference between the nutrients and locations in the C content was found

(428.85%, $p < 0.05$). Also, H concentrations were significantly higher in the case of Location 1 by 110.63% ($p < 0.05$).

Table 1. Nutrients composition of grape pomace from 2 different locations of Slovakia

Nutrient in g.kg-1	Location								P
	1				2				
	x	SD	min	max	x	SD	min	max	
DM	942.25	1.00	941.20	943.20	934.78	8.40	927.40	942.10	0.13
CP	98.70 ^a	1.02	97.39	99.77	103.75 ^b	3.03	100.58	107.74	0.02
EE	84.19 ^a	0.63	83.47	84.89	100.58 ^b	5.20	95.75	106.26	0.00
CF	183.98	1.04	182.67	185.22	180.85	16.76	164.33	195.84	0.72
A	39.72	0.36	39.19	39.97	39.06	2.45	36.83	41.19	0.61
NFE	593.42	2.69	591.37	597.28	575.76	21.88	555.89	596.18	0.16
OM	960.28	0.36	960.03	960.81	960.94	2.45	958.81	963.17	0.61
ADF	380.87 ^a	4.03	375.53	385.09	269.06 ^b	0.95	268.38	269.73	0.00
NDF	459.67 ^a	0.39	459.28	460.05	306.47 ^b	1.40	305.48	307.46	0.00
L	216.93 ^a	4.37	213.26	222.49	238.06 ^b	1.64	236.90	239.22	0.00
C	163.95 ^a	2.37	161.90	167.23	31.00 ^b	0.69	30.51	31.49	0.00
H	78.80 ^a	3.76	74.87	83.86	37.41 ^b	0.45	37.09	37.73	0.00

Abbreviations: g.kg⁻¹ - gram per 1 kilogram of DM, x - mean, SD - standard deviation, min - minimal value, max - maximal value, P - statistical significance (Independent sample T-test), DM - dry matter, CP - crude proteins, EE - ether extract, CF - crude fibre, A - ash, NFE - nitrogen free extracts, OM - organic matter, ADF - acid detergent fibre, NDF - neutral detergent fibre, L - lignin, C - cellulose, H - hemicellulose

Determined nutrient concentrations were reflected in the ratios of nutrients from OM (Figure 1). The highest concentrations in the case of NFE were observed. In the case of Location 1 it was 61.80 % and in the case of Location 2 59.92%. Then, grape pomace samples by high CF content, even higher than CP and EE content were observed. Thus, CF formed almost 20% of the OM (19.16% and 18.82%). The second lowest concentrations by CP were represented. Only, 10.28% respectively 10.80% of OM was formed by CP. However, the lowest ratio from nutrients by EE was represented. But, in the case of Location 2, higher content of EE (10.47%) compared to CP concentrations (10.28%) in Location 1 was found. On the other hand, in the case of Location 1 only 8.77% of EE from OM was determined. Neutral detergent fibre complex mainly by L content was formed (Figure 2). Its concentrations were from 47.19 to 77.68% and higher in Location 2. However, the ratio of C in the case of Location 1 (35.67%) compared to Location 2 (10.12%) was higher. Moreover, the ratio of H from NDF was also higher in the Location 1 (17.14) in comparison Location 2 (12.21%).

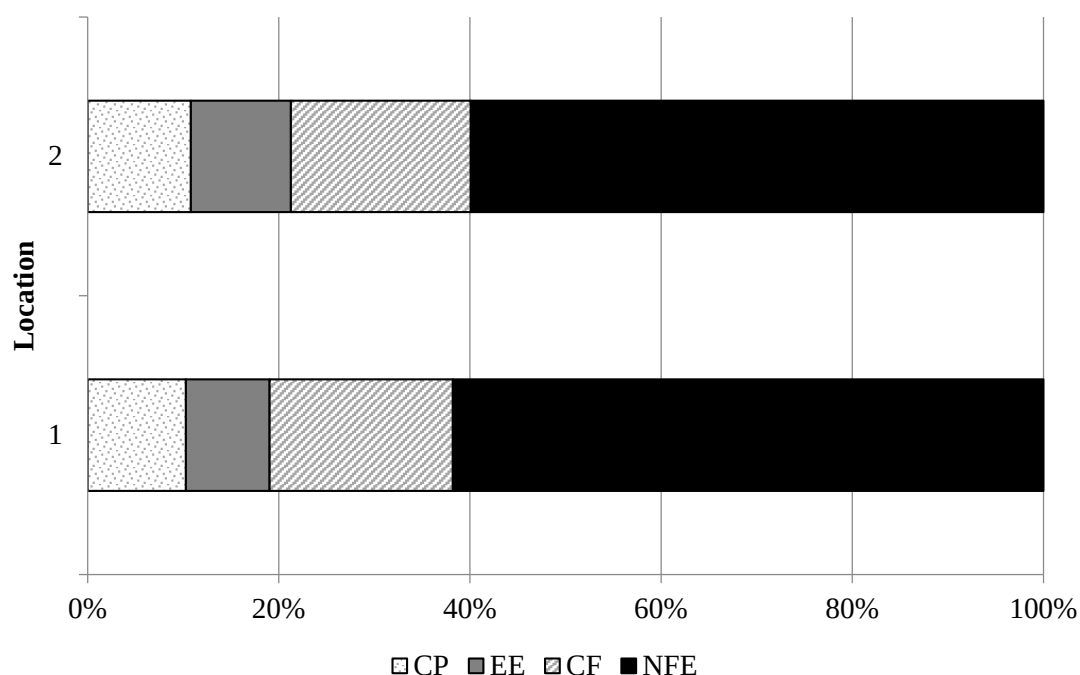


Figure 1. Grape pomace nutrients ratio in organic matter from 2 different locations
abbreviations: CP - crude proteins, EE - ether extract, CF - crude fibre, NFE - nitrogen free extracts

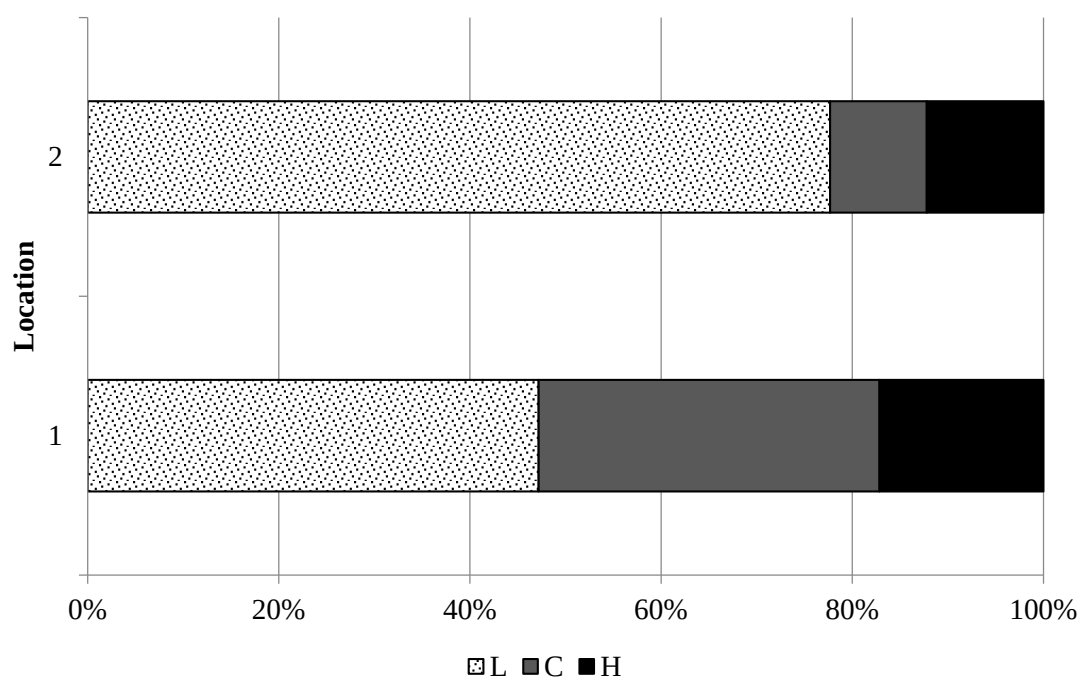


Figure 2. Grape pomace fibre fractions ratio in neutral detergent fibre from 2 different locations
abbreviations: L - lignin, C - cellulose, H - Hemicellulose

4. DISCUSSION

Grape origin and technical processing of wine productions leads to differences in the nutrient content of grape pomace (Baumgärtel et al., 2007). In the studies of Mote and Talib (2017) and Ziarati et al. (2017), DM content from 958 g.kg⁻¹ to 966 g.kg⁻¹ was found. The DM content in dry pomace was in our research lower in comparison with their findings. On the other side, CP content in our research was in interval from 77 to 175 g.kg⁻¹, which was reported by Peiretti et al. (2017) and Russo et al. (2017). In contrary, the content of EE was in our samples higher in comparison with Azevêdo et al. (2012) 74 g.kg⁻¹, Molina-Alcaide et al. (2008) 50 - 71 g.kg⁻¹ and Zalikarenab et al. (2007). Baumgärtel et al. (2007) found CF content in grape pomace from 199 to 312 g.kg⁻¹, that was in comparison with our results higher. Then, the content of A in our results was lower in comparison with study of Molina-Alcaide et al. (2008) and Zalikarenab et al. (2007) where the concentrations of A from 62 to 79 g.kg⁻¹ were found. However, Corbin et al. (2015) observed lower concentrations of NFE compared to our results (314 g.kg⁻¹ - 539 g.kg⁻¹) Then, Russo et al. (2017) determined in grape pomace interval of NDF 215 - 614 g.kg⁻¹ and ADF 173 - 561 g.kg⁻¹, which included results from our study. The content of L in the study of Baumgärtel et al. (2007) (202 to 267 g.kg⁻¹) was comparable to our findings. However, the content of C in comparison with the research of Zalikarenab et al. (2007) (80 - 90 g.kg⁻¹) and Molina-Alcaide et al. (2008) (110 g.kg⁻¹) depending on the location was higher or lower. On the other side, the content of H in Location 2 was in the interval of Zalikarenab et al. (2007) (31 - 54 g.kg⁻¹), but Molina-Alcaide et al. (2008) (89 g.kg⁻¹) found higher content of H in comparison with both locations.

5. CONCLUSIONS

Grape pomace nutritive value can be affected by locality of origin. The highest and statistically significant differences mainly in CP and EE were determined. But, larger differences in the fibre complex were found. Thus, larger differences in the content of ADF and NDF and smaller in the content L were determined. On the other side C and H concentrations were more variable between the locations in the comparison with other determined nutrients. The biggest ratio of organic matter was consisted from NFE in both localities. On the other side, EE and CP ratio in the second locality was higher in comparison with the first locality. Large differences in fibre complex between the locations were also reflected in the ration of C and mainly in L from the NDF concentrations.

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