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STUDIES ON THE QUALITY AND AUTHENTICITY CHARACTERISTICS OF SOME TYPES OF VINEGAR

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ABSTRACT

The quality and authenticity of vinegar depend on the raw material and on the production technology. This study aimed to evaluate the main chemical compounds and quality parameters that attest to the naturalness of white wine, red wine, apple, cider, spirit and rice vinegars. The wine, apple and cider vinegars were obtained in the laboratory, while the spirit and rice vinegars were purchased from the market. Extract, ash, total acidity, volatile acidity, non-volatile acids and carbohydrates were determined, and authentication ratios (volatile acidity/extract, volatile acidity/ash, fixed acidity/ash and extract/ash) were calculated. Total acidity ranged from 5.2 % acetic acid in rice vinegar to 11.5 % in spirit vinegar, with wine vinegars at about 9%. Volatile acidity was highest in red wine vinegar, and the best extract content (above 20 g/L) was found in wine and cider vinegars. Spirit vinegar showed the lowest extract and ash contents. The ash × 100/extract ratio was close to the ideal level of 10 % for wine, apple and cider vinegars (11.35–11.85), while rice vinegar showed a higher value (23.85). The results indicate that the analysed vinegars are natural and authentic with respect to the labelled raw materials.

INTRODUCTION

The quality of vinegar obtained from food sources depends on the production conditions and on the raw material. The techniques used in the vinegar manufacturing process influence the organoleptic properties of the final vinegar.

Determining the quality characteristics of local products is very important for promoting the marketing of vinegar. It is described as a natural remedy and is considered completely safe and healthy (Launholt et al., 2020).

Quality analysis provides the composition of each product in terms of desirable and undesirable ingredients, which may be potentially toxic. Quality assessment requires a panel of analyses, including the determination of component content and sensory analysis.

Acidity is considered a key factor in determining the quality of vinegar, and its content is at least 5 or 6 degrees (Kharchoufi et al., 2018).

The alcohol content is set at a maximum of 0.5 degrees for fruit vinegar and 1% for spirit vinegar (Kharchoufi et al., 2018). The same values are required by Codex Alimentarius Standard 79/19 (FAO-WHO. Codex Alimentarius Commission).

The pH of fruit vinegar ranged from 2.40 to 3.90.

Electrical conductivity (EC) is an important parameter for assessing the ability of vinegar to allow the passage of electric current and its relationship with the mineral content of the sample. EC values depend on the raw material used to produce the vinegar.

Acidity is an important criterion for examining the quality of vinegar. The high acidity values observed in apple vinegar produced in Turkey may be caused by the hyperoxygenation that occurs during the second stage of vinegar production (Ozturk et al., 2015).

The second criterion used to determine the quality of vinegar is the ethanol content, with the values reported for different vinegars ranging from 0.01 to 2.53 degrees. High ethanol content values were observed in date vinegar from Iraq.

Vinegar has been the subject of numerous research studies in recent decades. Studies are currently being carried out to determine and identify the phenolic composition of vinegar. The nature and quantity of the bioactive compounds present in vinegar are closely related to the raw material used to produce the vinegar, the technique selected for its production, and the nature of the microorganisms involved in the fermentation process (Patrignani et al., 2020; Xia et al., 2020). The active molecules that are naturally present or newly generated not only confer organoleptic properties such as astringency, taste and colour parameters. The bioactive ingredients of vinegar also play an important role in the prevention and treatment of various human conditions (Xia et al., 2018).

Several organic acids have been found in vinegar, including volatile organic acids (acetic acid, formic acid, propionic acid, butyric acid and quinic acid) and non-volatile organic acids (lactic acid, malic acid, pyroglutamic acid, citric acid and succinic acid). As a food product, the quality of vinegar depends on its various characteristics, including aroma, which is the most important quality criterion (Chen et al., 2020). Aroma is linked to the presence of organic acids in vinegar that are naturally present in the raw material or newly generated during the fermentation process.

Acetic acid is the most abundant acid in vinegar, accounting for approximately 92.64–93.22 % (Chen et al., 2020), followed by succinic acid at 3.92 to 6.43 %, while oxalic acid and malic acid were present in smaller amounts (Gao et al., 2017). The content of organic acids changed during the vinegar production process, with the lowest organic acid content found during alcoholic fermentation, followed by a gradual increase that was maintained during the second phase (acetic fermentation).

MATERIAL AND METHODS

Fruit vinegar is a popular natural product with multiple uses. It is highly appreciated and included in the daily diet of many people (Robledo-Márquez et al., 2022). The fermentation of fruit produces a bioliquid that contains several functional molecules (Liu et al., 2019), such as organic acids, polyphenols (Kelebek et al., 2017), melanoidins (Zhu et al., 2020).

The production technique used has an impact on the quality of the vinegar, while the vinegar-making process plays an important role in the removal and/or formation of new components. The traditional technique promotes the development of aroma and flavour owing to the slow production process.

Polyphenols and organic acids, mainly acetic acid, play an important role in the beneficial properties offered by fruit vinegar (Budak et al., 2014).

The following objectives were considered in carrying out this study:

1. Evaluation of the main chemical compounds that attest to the naturalness of wine, apple, cider, spirit and rice vinegars.

2. Evaluation of the main quality parameters that attest to the naturalness of wine, apple, cider, spirit and rice vinegars.

The following types of vinegar were used in this study: wine vinegar, apple vinegar, spirit vinegar and rice vinegar. The white and red wine vinegar samples, as well as the apple and cider vinegar samples, were obtained in the laboratory of the discipline. The last two samples, spirit vinegar and rice vinegar, were purchased from the market.

For all the vinegars analysed, the extract, ash, total acidity, volatile acidity and mineral acids were determined conformed with STAS 157-86.

To authenticate the vinegars included in the study, the following ratios were determined: volatile acidity/extract, volatile acidity/fixed acidity, volatile acidity/ash, fixed acidity/ash and extract/ash, parameters that define the naturalness of these products and the organic nature of the raw material used. The analyses were carried out in the Oenology laboratory of the Faculty of Horticulture (Stoica Felicia, 2012).

RESULTS AND DISCUSSIONS

Table 1 presents the levels of the main compositional characteristics of the vinegars analysed.

The total acidity contents are in agreement with the levels established for this characteristic for the types of vinegar analysed, differentiated by the raw material used to obtain them.

Spirit vinegar has the highest total acidity value.to 11.5 % acetic acid. In wine vinegar the total acidity is 9.0 % acetic acid (9.1 % for white wine vinegar and 9.2 % for red wine vinegar), 6.9 % acetic acid at apple vinegar, 7.5 % acetic acid at cider vinegar and in rice vinegar 5.2 % acetic acid.

Table 1.

Compositional characteristics of the vinegars analysed

Sample	Total acidity % acetic acid	Volatile acidity % acetic acid	Non-volatile acids % acetic acid	Carbohy-drates g/L	Extract g/L	Ash g/L
White wine vinegar	9.10	5.55	0.20	3.1	21.31	2.47
Red wine vinegar	9,20	6.10	0.35	2.5	23.20	2.75
Apple vinegar	6.90	3.20	0.15	1.9	19.2	2.18
Cider vinegar	7.50	3.35	0.25	1.5	20.1	2.30
Spirit vinegar	11.5	-	-	-	2.46	0.20
Rice vinegar	5.2	3.79	0.10	0.5	10.52	2.51

Volatile acidity was, in all cases, around 3 % acetic acid, and above 5 % acetic acid in white and red wine vinegar. Moreover, the highest value is recorded, as expected, in red wine vinegar.

The non-volatile acids, with contents that did not exceed 0.35 % acetic acid, are entirely appropriate, given the technological conditions under which the vinegars analysed are generally obtained.

The carbohydrate contents showed marked variability, ranging from 0.5 g/L (rice vinegar) to 3.1 g/L (white wine vinegar).

The best extract content (20 g/L and above) was shown by both white and red wine vinegar and by cider vinegar, closely followed by apple vinegar, given both the raw material used and the traditional production technology. The lowest extract content is recorded in spirit vinegar. The highest extract value is found in red wine vinegar.

Ash contents of over 2 g/L were found in white wine vinegar (2.47 g/L), red wine vinegar (2.75 g/L), cider vinegar (2.30 g/L), apple vinegar (2.18 g/L) and rice vinegar (2.51 g/L). The lowest ash content is recorded in spirit vinegar.

Owing to its quality level, wine vinegar, both white and red, enjoys ever wider appreciation among consumers and specialists. Apple, cider and rice vinegars have also been positively appreciated, although they are not very widely known among ordinary consumers.

Lately, given the competition already present on the Romanian market, the demands of informed consumers have increased considerably, especially for vinegars with various preservation properties. There is also a growing demand for varieties of vinegar used as a condiment in association with different culinary preparations.

Table 2 presents the main authentication indicators of these vinegars.

Table 2.

Main authentication indicators of the vinegars

Sample	Vol. acid./ Extract	Vol. acid./ Ash	Fixed acid/ Ash	Extract/ Ash
White wine vinegar	0.26	2.24	3.68	11.59
Red wine vinegar	0.27	2.21	3.34	11.85
Apple vinegar	0.16	1.46	3.16	11.35
Cider vinegar	0.17	1.47	3.26	11.44
Spirit vinegar	0	0	57,5	8.13
Rice vinegar	0.36	1.50	2.07	23.85

A first finding from the analysis of the data in Table 2 is that not all quality parameters could be determined for all the types of vinegar analysed, which leads to a partial analysis of them. The first two parameters could not be calculated for the spirit vinegar sample.

Nevertheless, the most important indicators of the quality and naturalness of vinegars, Acidity/Ash and especially Extract/Ash, record conclusive values in this respect.

Thus, for Acidity/Ash the values range between 2 and 4, with the exception of spirit vinegar, for which the value is much higher than the others. The only explanation is its lowest ash content.

To determine the *extract–ash ratio*, the extract is taken as 100 %, and the ash is expressed as a percentage of the extract. There is no linear relationship between the reduced extract and the ash.

Thus, for this indicator, the ratio ash × 100 / non-reducing extract came considerably close to the ideal level (10 %) for white wine vinegar (11.59), red wine vinegar (11.85), apple vinegar (11.35), cider vinegar (11.44) and rice vinegar (23.85).

The values of the ash × 100 / extract ratio represent an important criterion for the quality and compositional balance of the products.

It can be concluded, from the values obtained for the two quality indices, that all the types of vinegar analysed are natural (wine, apple and rice vinegars) and authentic with respect to the labelling of the raw materials used.

CONCLUSIONS

The total acidity contents are in agreement with the levels established for this characteristic for the types of vinegar analysed, differentiated by the raw material used to obtain them.

In wine vinegar, total acidity records values of over 9.0 % acetic acid, and in rice vinegar 5.2 % acetic acid.

Volatile acidity was, in all cases, around 4 % acetic acid.

The best extract content (20 g/L) was shown by white and red wine vinegar and by apple and cider vinegar, given both the raw material used and the traditional production technology.

The most important indicators of the quality and naturalness of vinegars, Acidity/Ash and especially Extract/Ash, record conclusive values in this respect.

The values of the ash × 100 / extract ratio represent an important criterion for the quality and compositional balance of the products.

It can be concluded, from the values obtained for the two quality indices, that all the types of vinegar analysed are natural and authentic with respect to the labelling of the raw materials used.

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