2013 2nd International Conference on Nutrition and Food Sciences
IPCBEE vol.53 (2013) © (2013) IACSIT Press, Singapore
DOI: 10.7763/IPCBEE. 2013. V53. 8

The Effect of Blending on Sensory Characterictics of Apple Cider

Rita Riekstina- Dolge [+], Zanda Kruma, Evita Straumite and Daina Karklina

Latvia University of Agriculture, Faculty of Food Technology

Abstract. For the experiment, five varieties of apples belonging to different classes were used: sweet (‘Auksis’), sharp (‘Lietuvas Pepins’, ‘DI-93-4-14’, ‘Remo’), and bittersharp (‘Kerr’) apples. Fermentation was performed using commercial *Saccharomyces bayanis* yeast. Blends of different apple juices were prepared using sweet / sharp / bittersharp apples in different proportions – 1:1:1 and 2:1:2. Two approaches of blending were used – before and after fermentation. Nine sensory properties – namely: clarity; apple, fruit and yeast aromas; apple, yeast, sour, astringent and bitter tastes– were analyzed using a line scale. More intense fruit aroma, apple aroma and taste showed up in cider samples blended before fermentation. The best proportion of sweet, sharp and bittersharp apples depended on apple variety used. In blends with ‘Remo’ and ‘Lietuvas Pepins’ better results showed in ciders with a proportion of 2:1:2, whereas for ‘DI-93-4-14’ – a proportion of 1:1:1. Generally better results showed in ciders made with ‘Remo’ apple juice blended before fermentation.

Keywords: Apple cider, Sensory properties, Blending, Cider fermentation

1. Introduction

Apples are one of the most widely grown fruits in Latvia and are a good raw material for apple cider. Cider is usually defined as a gasified and low alcoholic beverage made from apple juice extracted through milling and pressing procedures [1]. Cider can be made with different technologies, and the additions of sugars and carbon dioxide are permitted, as well as the use of different stabilization processes, and cider can be produced from concentrated apple juice or fresh apple must. The French or “Natural cider” method includes oxidative fermentation caused by apiculate yeast with a low alcoholic fermentation activity resulting in fruity and floral smells, thus improving the quality of the final product [2]. The blending of wines (coupage, assemblage) is frequently used in wineries to equilibrate the composition of wines, to increase their stability, to standardize a product with particular original characteristics. Wines are blended to improve their colour, taste, alcohol content, composition and body or aroma, with the final aim of enhancing the product quality [3], [4]. Most of the studies found in the literature related to wine blending are based on meeting certain desired sensorial characteristics mainly related to wine aroma compounds [5], [6] and [7]. Similarly, the flavor of cider depends on the blending of juices from different apple varieties and production technologies. Ciders are produced from sharp, bittersharp, bittersweet and sweet cider apples, and classification is based on apple sensory properties, acid and poliphenolic content. For cider makers it is important to know the chemical composition of each apple variety to create the perfect balance between sweetness and tartness [8].

For consumers, the organoleptic quality of a product is often the decisive factor in a purchase, thus it is very important to determine the factors affecting food product attributes, acceptance and preference [10], [11], [12]. Among the many organoleptic quality components, flavour occupies a particular place, i.e. the odour and taste sensations received when ingesting. The presence, contents and composition of volatile substances in food have a substantial influence on its quality [9].

[+] Corresponding author. Tel.: + 3713005647; fax: +37163022829
E-mail address: rita.riekstinadolge@llu.lv

Latvian consumers prefer homemade apple wine, or wine produced by small enterprises, usually above 7% to 14% alcohol content, semi-sweet or sweet. Natural fermented cider is usually about 5.5 % alcohol content and is dry, or semi-dry. In Latvia, cider drinking culture is not popular yet, but the development of commercial orchards and apple processing modes shows that it would be possible to promote cider consumption

The aim of the current research was to evaluate the influence of blending approaches on the sensory properties of cider.

2. Materials and Methods

2.1. Raw Materials

Five varieties of apples - ‘Auksis’, ‘Lietuvas Pepins’, ‘DI-93-4-14’, ‘Remo’ and ‘Kerr’ - grown at the Latvia State Institute of Fruit Growing, were used in the experiment. Apples were harvested in September and October 2010. Juice was obtained by the mechanical press Voran Basket Press 60K (Voran Maschinen GmbH, Austria). For stabilization of the juice before fermentation, ‘Tannisol’ (Enartis, Italy) was added. Tannisol capsules consist of potassium metabisulphite (added amount to juice – 9.5 g 100 L^{-1}), ascorbic acid (0.3 g 100 L^{-1}) and tannin (0.2 g 100 L^{-1}). Sulphites have various permitted uses: their primary function is as a preservative and antioxidant to prevent or reduce spoilage [13], and they help to stabilize product colour and inhibit discolouration, thereby improving the appearance and flavour of many foods during preparation, storage and distribution [14].

2.2. Blending Approaches and Fermentation Conditions

Each cider sample was prepared using the juices of three apple varieties: sweet (‘Auksis’), bittersharp (‘Kerr’) and sharp (‘Lietuvas Pepins’, ‘DI-93-4-14’, ‘Remo’). All blendings differed in the proportions of apple juice types and also by sharp type apple used. Part of each apple juice sample was fermented separately, and after fermentation blended in two proportions - 1:1:1(sweet : sharp : bittersharp) and 2:1:2 (sweet : sharp: bittersharp). Other juice samples were blended as previously described before fermentation. Samples were labeled according to blending approach and type of sharp apple juice used (Table I.).

Table I: Apple cider samples description

Code	Apple variety and proportion in cider	Blending approach	Code	Apple variety and proportion in cider	Blending approach
R_1_BF	Auksis : Remo : Kerr 1 : 1 : 1	blended/fermented	R_2_BF	Auksis : Remo : Kerr 2 : 1 : 2	blended / fermented
R_1_FB	Auksis : Remo : Kerr 1 : 1 : 1	fermented/blended	R_2_FB	Auksis : Remo : Kerr 2 : 1 : 2	fermented / blended
DI_1_BF	Auksis : DI-93-4-14: Kerr 1 : 1 : 1	blended/fermented	DI_2_BF	Auksis : DI-93-4-14 : Kerr 2 : 1 : 2	blended / fermented
DI_1_FB	Auksis : DI-93-4-14 : Kerr 1 : 1 : 1	fermented/blended	DI_2_FB	Auksis : DI-93-4-14 : Kerr 2 : 1 : 2	fermented / blended
LP_1_BF	Auksis : Lietuvas Pepins : Kerr 1 : 1 : 1	blended/fermented	LP_2_BF	Auksis : Lietuvas Pepins : Kerr 2 : 1 : 2	blended / fermented
LP_1_FB	Auksis : Lietuvas Pepins : Kerr 1 : 1 : 1	fermented/blended	LP_2_FB	Auksis : Lietuvas Pepins : Kerr 2 : 1 : 2	fermented / blended

Fermentation was performed using the commercial *Saccharomyces bayanis* yeast 'EC-1118’ (Lalvin, Lallemand Inc., Canada). This same yeast is also recommended for all types of wines, including sparkling wines, late harvest wines and ciders. Fermentation was carried out at 16±1 °C for 28 days in laboratories at the Latvia University of Agriculture Faculty of Food Technology. The apple juice was fermented in glass bottles (for each cider type n=5) with a volume of 750 ml. For analysis the cider samples were combined from the five bottles in equal proportions.

2.3. Sensory Analysis

Sensory evaluation of the apple cider was carried out by a panel of ten participants (nine women and one man, aged 28–63 years) belonging to the experts of the beverage technology on enterprises. Nine sensory properties – namely: clarity; apple, fruit, yeast aromas; apple, yeast, sour, astringent and bitter tastes – were analyzed using a line scale (ISO 4121:2003). Intensity of clarity was defined from 'clear' to 'cloudy'. For other properties, intensity was described as ranging from 'not perceptible' to 'strongly perceptible'.

2.4. Statistical Analysis

Analysis of variance was performed using two-way ANOVA procedure to detect significant differences for sensory attributes and blending approaches of the twenty cider samples, and $p<0.05$ was considered statistically significant. Linear correlation analysis was performed by SPSS 17.00 software for Windows.

3. Results and Discussion

Evaluations of the ciders' sensory properties are presented in Fig. 1. In this research, the authors selected apple aroma and taste, and fruit aroma, as the most desirable cider sensory properties, but as less preferable - yeast taste and yeast aroma.

Ciders R_2_BF and DI_1_BF had more intensive apple aroma and taste and fruit aroma. Also for these samples lowest yeast aroma and taste were observed. Samples DI_2_FB and DI_2_BF showed the lowest intensity of apple aroma and taste and fruit aroma.

According to two-way ANOVA, the effect of different blending approaches was significant ($p<0.05$) for the all sensory properties. The type of sharp apple variety used for cider production was significant ($p< 0.05$) for the following sensory properties: clarity, apple aroma, fruit aroma, yeast aroma apple taste and astringent taste. Blending approach was significant for clarity, apple aroma, fruit aroma yeast aroma yeast taste, sour taste and bitter taste. Interactions between the two factors – blending approach and apple variety - were significant for all sensory properties except apple taste. Total evaluation of sensory properties showed that the samples made from the variety 'Remo' apples had the highest clarity and more pronounced apple aroma, while the samples made from the 'DI-93-4-14' apples had less yeast aroma.

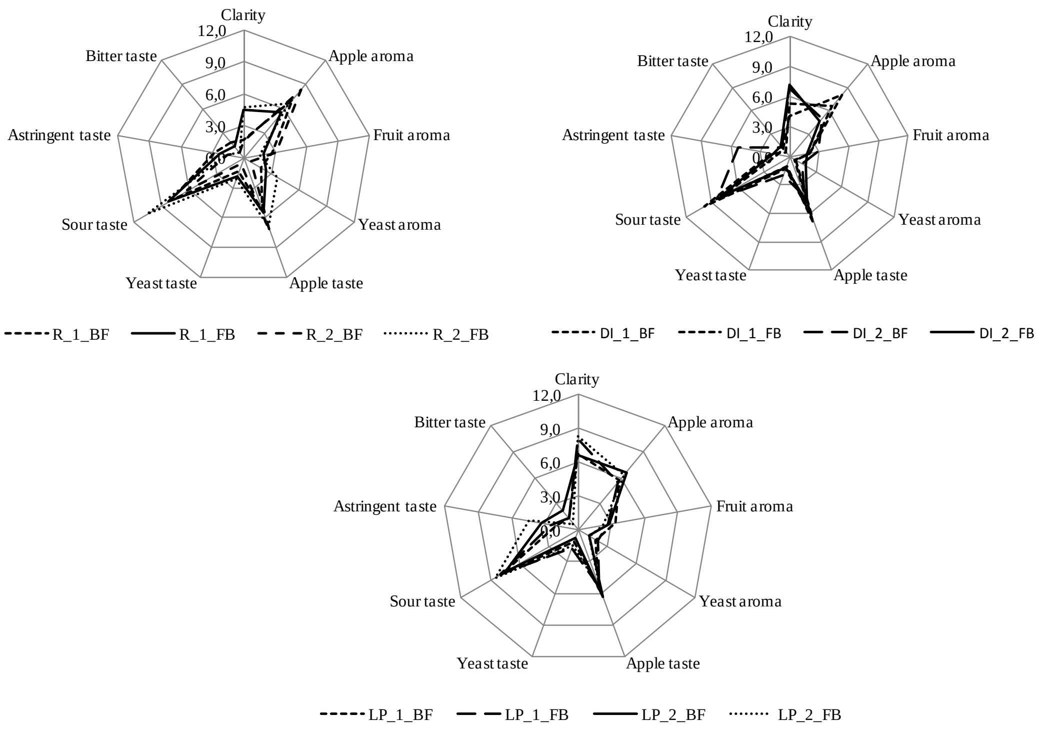

Fig. 1: Spider plot for sensory properties of cider samples

Assessment of blending impact was also carried out using correlation analysis. The correlation coefficients among the sensory properties are shown in Table II and Table III. Significant correlation (p<

0.05) was found between apple aroma and apple taste in both blending approaches used, respectively, fermented/ blended samples (r=0.871) and blended/ fermented (r=0.871).

In fermented/ blended samples, apple aroma strongly positive correlated with sour taste (r=0.827), and had a strong negative correlation with bitter taste (r=-0.910) (Table II). These samples are characterized by acidic taste and less bitter taste. The blended/ fermented samples (Table III) showed a moderate negative correlation between apple aroma and yeast aroma (r=-0.664), yeast taste (r=-0.732), sour taste (r=-0.682) and astringent taste (r=-0.774). In fermented/ blended samples, yeast aroma had a strong positive correlation with yeast taste, but in blended/ fermented samples correlation is moderately positive (r=0.592). Apple taste strongly negatively correlated with yeast taste (r=-0.942) and astringent taste (r=- 0.835) in the blended/ fermented samples, while apple taste strongly positively correlated with sour taste (r=0.973) and had a strong negative correlation with bitter taste (r=-0.835) on the fermented/ blended samples. The blended/ fermented samples with pronounced apple taste had less pronounced yeast, astringent and sour taste, while the fermented/ blended samples were more acidic taste with a less bitter taste.

Table II: Correlation matrix among the descriptive terms for fermented /blended cider samples

Variables	Clarity	Apple aroma	Fruit aroma	Yeast aroma	Apple taste	Yeast taste	Sour taste	Astringent taste	Bitter taste
Clarity	1								
Apple aroma	-0.329	1							
Fruit aroma	0.676	-0.079	1						
Yeast aroma	-0.427	0.027	-0.468	1					
Apple taste	-0.583	**0.894***	-0.389	0.359	1				
Yeast taste	-0.427	0.353	-0.123	**0.819***	0.486	1			
Sour taste	-0.581	**0.827***	-0.504	0.300	**0.973***	0.316	1		
Astringent taste	0.600	0.238	0.509	-0.414	-0.175	-0.054	-0.279	1	
Bitter taste	0.188	**-0.910***	0.243	0.062	**-0.835***	-0.076	**-0.855***	-0.209	1

*Significant at p<0.05

Table III: Correlation matrix among the descriptive terms for blended/ fermented cider samples

Variables	Clarity	Apple aroma	Fruit aroma	Yeast aroma	Apple taste	Yeast taste	Sour taste	Astringent taste	Bitter taste
Clarity	**1**	-	-	-	-	-	-	-	-
Apple aroma	-0.790	**1**	-	-	-	-	-	-	-
Fruit aroma	0.167	-0.449	**1**	-	-	-	-	-	-
Yeast aroma	0.191	-0.664	0.588	**1**	-	-	-	-	-
Apple taste	-0.443	**0.871***	-0.278	-0.771	**1**	-	-	-	-
Yeast taste	0.320	-0.732	0.024	0.592	**-0.942***	**1**	-	-	-
Sour taste	0.544	-0.682	-0.235	0.511	-0.774	**0.811**	**1**	-	-
Astringent taste	0.517	-0.774	0.177	0.384	**-0.816***	0.753	0.516	**1**	-
Bitter taste	0.331	-0.331	-0.048	0.419	-0.348	0.160	0.438	0.377	**1**

*Significant at p<0.05

Comparing the two types of blending approaches, clarity correlated moderately positively with sour (r=0.544) and astringent tastes (r=0.517), and moderately negatively with apple aroma (r=-0.790) Results showed a moderate positive correlation between clarity and fruit aroma (r=0.676), clarity and astringent taste (r=0.600) and a moderately negative correlation between clarity and apple taste (r=-0.583) and clarity and sour taste (r=-0.581). Blended/ fermented samples with the highest clarity had a pronounced apple aroma and showed less intense sour and astringent taste. Fermented/ blended samples with highest clarity had less fruity and astringent taste, but were higher in apple and sour taste. The results show that the method affects the sensory properties and their mutual interaction.

4. Conclusions

More intense fruit aroma, apple aroma and taste showed in samples blended before fermentation. The best proportion of sweet, sharp and bittersharp apples depends on the apple variety used. Total evaluation of the sensory properties showed that ciders from the variety ‘Remo’ apples had high clarity and more intensive apple aroma. The ‘DI-93-4-14’ apple ciders had less pronounced yeast aroma. In blends with ‘Remo’ and ‘Lietuvas Pepins’ better results showed in ciders with a proportion of 2:1:2, whereas for variety ‘DI-93-4-14’ a proportion of 1:1:1. Generally better results showed in ciders made with ‘Remo’ variety apple juice.

5. Acknowledgements

This research has been done within the State Research Programme “Sustainable use of local resources (earth, food, and transport) – new products and technologies (NatRes)” (2010-2013) Project no. 3. „Sustainable use of local agricultural resources for development of high nutritive value food products (Food)”, and ESF project “Support for the implementation of LLU doctoral studies” contract No. 2009/0180/1DP/1.1.2.1.2/09/IPIA/VIAA/017. The authors also acknowledge the Latvia State Institute of Fruit Growing for supplying us with apples.

6. References

[1] J. J. M.,Laplace, A. Jacquet, I. Travers, J.P. Simon. Incidence of land and physicochemica composition of apples on the qualitative and quantitative development of microbial flora during cider fermentations. *J. of the Inst. of Brew.*, 2001, 107 (4): 227-233.

[2] J. J. Mangas, M.P. Gonzalez, R. Rodrıguez, D. Blanco. Solid phase extraction and determination of trace aroma and flavour components in cider by GC-MS. *Chromatographia*, 1996, 42: 101–105.

[3] B. Rankine, Blending: A most important aspect of winemaking. *Aust. Grapegrow. Winemak.* 1988, 289: 17–18.

[4] R. B. Boulton, V.L. Singleton, L.F Bisson, R.E. Kunkee. *Principles and Practices of Winemaking*. Chapman & Hall, NewYork, 1996.

[5] S. Datta, S. Nakai. Computer-aided optimization of wine blending, *J. Food Sci*., 1992, 57: 178–182.

[6] F. Iacono, G. Nicolini, E. Alonzo. Wine blending tech-niques and examples of qualitative result definition (sensory properties). *Vigne Vin*, 1999, 26: 81–86.

[7] J. G. Ferrier, D.E. Block. Neural-network-assisted optimization of wine blending based on sensory analysis. *Am. J.Enol. Vitic.* 2001, 52: 386–395.

[8] A. G. H Lea., J. F. Drilleau. *Fermented Beverage Production*. Kluver Academic /Plenum, New York, 2003.

[9] B. Plutowska, W. Wardencki. Aromagrams – Aromatic profiles in the appreciation of food quality. *J.Food Chem*., 2007, 101: 845–872.

[10] Dos A., Ayhan Z., Sumnu G. (2005) Effects of different factors on sensory attributes, overall acceptance and preference of Rooibos (*Aspalathus lineares*) tea. *J.of Sensory Studies*, 20, pp. 228–242.

[11] Medeiros de Melo L.L.M, Bolini H.M.A., Efraim P. (2009) Sensory profile, acceptability, and their relationship for diabetic/reduced calorie chocolates, *Food Quality and Preference*, 20, pp. 138–143.

[12] G. Ares, S. Barrios, C. Lareo, P. Lema. Development of a sensory quality index for strawberries based on correlation between sensory data and consumer perception. *Post H Biol. and Technol.* , 2009, 52: 97–102.

[13] T. Fazio and C.R. Warner. A review of sulphites in foods: Analytical methodology and reported finding. *Food Addit. Contam.*, 1990, 7: 433–454.

[14] J.B. Adams. Food additive-additive interactions involving sulphur dioxide and ascorbic and nitrous acids. *J.of Food Chem*. 1997, 59: 401- 409.