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RESEARCH ON THE CORRELATION BETWEEN PHYSICO-CHEMICAL, SENSORY ANALYSIS OF SMOOTHIE TYPE PRODUCTS AND CONSUMER PREFERENCES

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Abstract

Numerous studies have documented the prevention of certain chronically diseases, e.g. hypertension, coronary heart diseases, and the risk of stroke by consuming an adequate amount of fruits and vegetables.
To increase the intake of phytochemicals, the food industry offers smoothies as an alternative or addition to the consumption of fresh fruits.Their production is based on the usage of the entire fruit, which is processed from pulp to puree, the seeds and the peel being removed. To develop different flavors and to obtain the appropriate texture of the final product the juice from the corresponding fruits is used as well. Smoothie products are characterized by a high concentration of nutrients and a low content of energy.
The aim of this study is to develop new high quality products based on mixtures of pressed and squeezed fruit without adding preservatives, stabilizers or chemical correctors of pH and acidity. For this purpose, some mixtures of several pressed fruit like apples, pears, bananas, mango, peaches, cherry, strawberries and orange, maracuja, apples or grapes juices, have been made.
The sensorial analysis tests have shown that a Brix degree equal with 13 and a pH smaller than 4, are the ideal values for the microbiologic stability of the newly developed products. These values have been corrected by the addition of grape juice for the samples with a low pH and a low Brix degree and by the addition of orange juice for the samples with a high pH and a high Brix degree.
The structure and the physico-chemical properties of the smoothies have an essential role in the increase of taste as well as the sensorial perception of the consumers. The texture is a critical attribute of quality which influences the consumer's acceptance of the smoothies, being in this way of a major interest in the development of the product.

Keywords: *fruit smoothie, sensory analysis, quality, new products development.*

INTRODUCTION

In recent time, the demand for fresh fruit juices and smoothies with high quality level has been growingquickly.
Structure of food and its physico-chemical characteristics have a significant effect in the mouth and thus, on the sensory perception (Wilkinson, Dijksterhuis, & Minekus, 2000). Texture is a quality attribute that is critical in influencing the acceptability of raw and processed fruits so it is of primary concern in product development.
Sensory descriptive analysis is one of the most powerful, sophisticated and most extensively used tools in sensory science. Its application has steadily grown in the end of the 20th century and the beginning of the 21st. This methodology enables to measure the sensory reaction to the stimuli resulting from the consumption of a product, providing a description of the qualitative and quantitative aspects of human perception, and allowing correlations to other parameters (Lawless & Heymann, 2010; Moussaoui & Varela, 2010; Murray, Delahunty, & Baxter, 2001; Stone & Sidel, 2004).
Fruit and vegetable purees are considered as concentrated suspensions where the dispersed phase (pulp) consists of soft (deformable) insoluble particles (cell wall clusters) that are dispersed into an aqueous solution (serum) of sugars, organic acids, salts and pectic substances (Cepeda & Gomez, 2002; Qiu & Rao, 1989; Rao, 1999; Sato & Cunha, 2009)
Numerous studies have documented the prevention of certain chronical diseases, e.g. hypertension (Dauchet et al., 2007), coronary heart diseases (Dauchet, Amouyel, Hercberg, & Dallongeville, 2006; He, Nowson, Lucas, & MacGregor, 2007), and the risk of stroke

(Dauchet, Amouyel, & Dallongeville, 2005; He, Nowson, & MacGregor, 2006) by consuming an adequate amount of fruits and vegetables. These diseases are still responsible for the highest mortality rate in Western countries, such as Germany (DeStatis, 2008). Furthermore, polyphenolic compounds such as tea flavonoids (Stoner & Mukhtar, 1995), oligomeric procyanidins (Gerha¨user, 2008), and anthocyanins (Wang & Stoner, 2008) are implicated in the prevention of cancer. The daily uptake of fruits and vegetables was estimated to be lower than the recommended dietary intake (RDI), advised by the German Nutrition Society (DGE), of 650 g (250 g fruits, 400 g vegetables), especially for vegetables (Max-Rubner-Institut, 2008). To increase the consumption of fruits and vegetables, Germany started the campaign ''5 a day'' on the basis of the American one initiated by the National Cancer Institute (Rechkemmer, 2002). To increase the intake of phytochemicals, the food industry offers smoothies as an alternative or addition to the consumption of fresh fruits and vegetables. Smoothies belong to fruit juices and this term is used since 70 years, primarily in the USA and UK, recently also in Germany. Their production is based on the usage of the total fruits, which are processed to pulp or puree, partially with pieces.

Seeds and peel are removed (Qian, 2006). To create different flavours and to allow a drinkable texture, corresponding fruit juices are used. Smoothies are characterised by a high nutrient concentration with low energy content (Watzl, 2008).Smoothies are blended beverages containing fruit, fruit juice, ice, yoghurt, milk; and are a popular way of consuming fruit (Safefood, 2009). These products are typically purchased freshly prepared from juice bars or as a processed product (mildly pasteurised) from the chilled section of retail outlets. Despite worsening global economic conditions, smoothies remain a popular and convenient way of consuming fruit. In fact, the world smoothie market is projected to touch $9 billion by the year 2015 (Global Industry Analysts, 2010). This is primarily driven by rising health consciousness among consumers, on-the-go consumption, convenience, and perceived fresh like taste offered by smoothies.

The aim of this study is to develop new high quality products based on mixtures of pressed and squeezed fruit without adding preservatives, stabilizers or chemical correctors of pH and acidity. For this purpose, some mixtures of several pressed fruit like apples, pears, bananas, mango, peaches, cherry, strawberries and orange, maracuja, apples or grapes juices, have been made.

The obtained mixture were analysed in comparison with the market samples bought from Austrian and German markets (3 brands).

MATERIALS AND METHODS

Samples

The pressed fruit and the juices were purchased from Austria, being packed in containers of different sizes and frozen at-18^{0}C. By mixing different fruit piurees were generated 4 smoothies recipes like: peach-mango, orange-maracuja, sourcherry-banana and banana-strawberry.

Physico-chemical analysis

pH determination

pH was determined with a pH meter WTW INOLAB 720 series type with automatic temperature compensator, whose pH domain is between 0,00-14.00, with a precision of ± 0,01.

Titratable acidity (TA)

Titratable acidity was determined by titrating 10 g of homogenized smoothie sample with 0.1 N NaOH to an end point of pH 7.3 using Schott automatic titrator type Titronic basic. TA was analyzed in triplicate and expressed as citric acid/100 g product.

Brix degree determination

This method evaluates the content of total soluble sugar content, by measuring index of refraction. Index of refraction was determinated with a digital handheld Refractometer Reichert AR 200.

Consumer acceptance and preference tests

Before determining the final recipes, numbers of attempts tested by a small group of consumers were made.

Final tests, before production, were done on 50 consumers, from which 52% were women and 48% men with ages between 20-29 years. They were divided into two groups, the first group had as objective to evaluate the degree of

acceptance for the 4 recipes, while the second group had the objective of evaluate the suitability and the degree of perception between recipes.

Figure 1. View from acceptance and preferences tests

Scheme of testing for group 1 was: 4 products (1A, 2A, 3A, 4A) with monadic assessment.

Scheme of testing for group 2 was: 8 products presented simultaneously – pair comparative (1A-1B, 2A-2B, and 3A-3B, 4A-4B)

Sample 1B, 2B, 3B and 4B were purchased from Austrian local fruit market.

Our purpose for acceptance level was 70%, and for preference 60/40.

The acceptance threshold of 70% means that the product can be accepted in case of obtainning at least 70% of the scale of assessment. The scale used is 9 points and therefore the minimum acceptance threshold is given by a score of 6.3. If the acceptance average points is higher than 6.3, the product meets the criterion of the acceptance required in research objective.

It is similar in the case of preference test. The research objective was to set a minimum threshold 60/40, which means that the product was the favorite from at least 60% of the respondents that analyzed a pair of products (it is a product with a significantly higher preference level). In opposition, a product that obtain 40% or less at preference test, is a product with a significantly preference low level, and rejected from the research objective. In case the both analyzed pairs were obtained scores between 40-60, these show a similar preference level.

RESULTS AND DISCUSSIONS

The obtained results showed that the values of newly developed products pH between 3.73 and 4.19, the acidity between 0. 524 g citric acid/100 g product and 0.984 g citric acid/100 g product, and Brix degree between 13.2 and 15.2, have been similar with products purchased on the market.

To reach the proposed values, recipes have been corrected by the addition of grape juice for the samples with a low pH and a low Brix degree and by the addition of orange juice for the samples with a high pH and a high Brix degree.

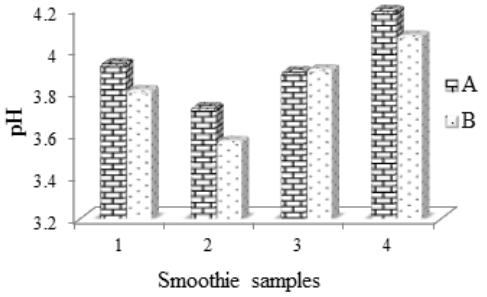

Figure 2. The graphical representation of the pH values for the smoothie samples, A-newly developed products, B-market products

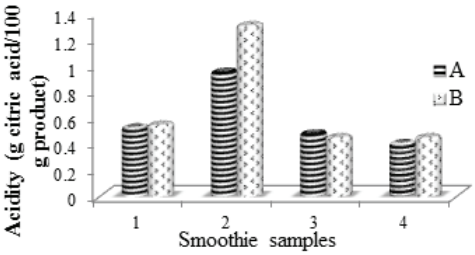

Figure 3. The graphical representation of the titratable acidity values for the smoothie samples, A-newly developed products, B-market products

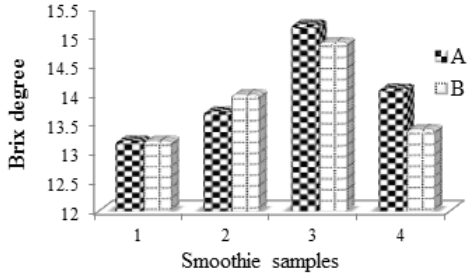

Figure 4. The graphical representation of the Brix degree values for the smoothie samples, A-newly developed products, B-market products

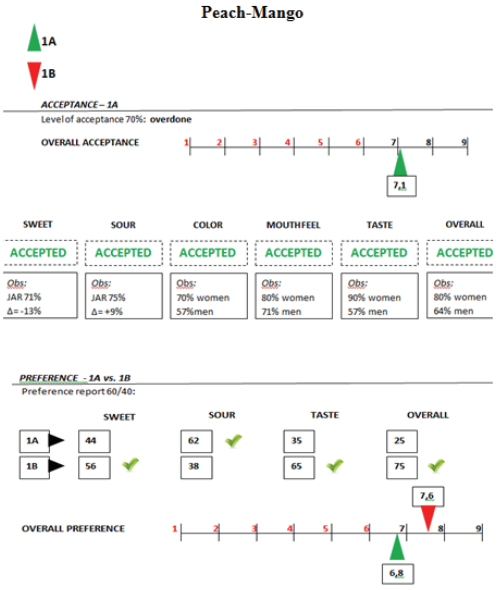

Figure 5. Acceptance and preference tests for Peach-Mango recipe

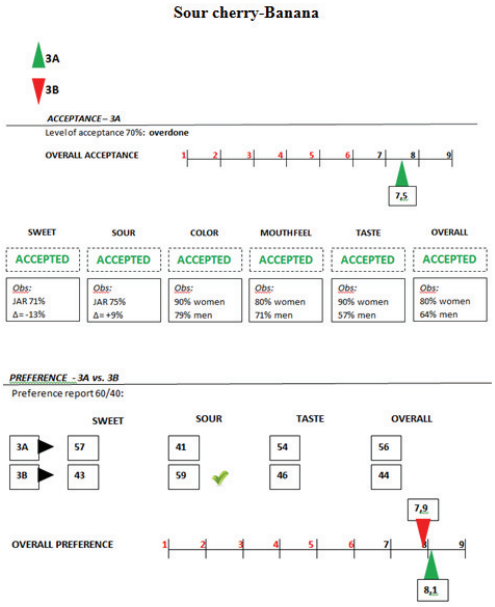

Figure 7. Acceptance and preference tests for Sour cherry-Banana recipe

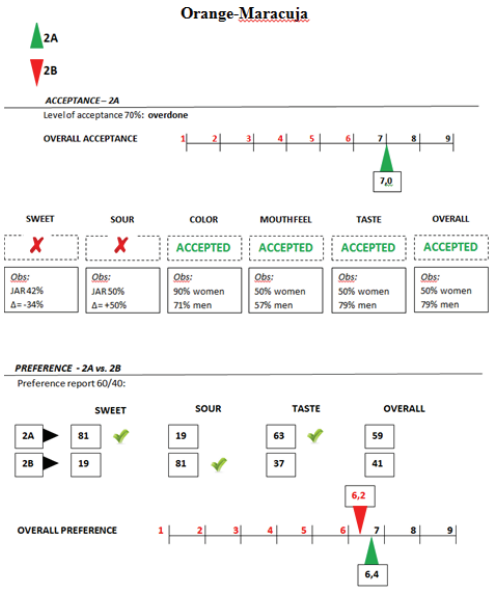

Figure 6. Acceptance and preference tests for Orange-Maracuja recipe

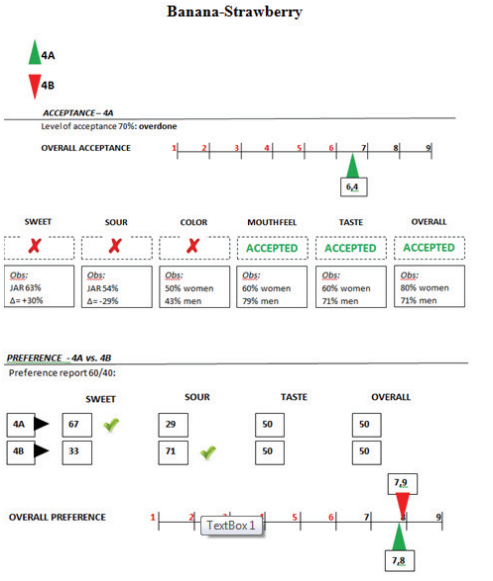

Figure 8. Acceptance and preference tests for Banana-Strawberry recipe

CONCLUSIONS

The texture and physico-chemical properties of food products have an important role in the creation of taste and sensory perception.

These are critical quality attributes affecting the acceptability of fruits, fresh or processed, thus being of major concern in new product design.

The sensorial analysis tests have shown that a 13 Brix degree and a pH between 3.7 and 4.2 values –fit very well with the consumer acceptance and preference.

More, the acceptance and preference tests have shown that the newly developed products meet required criteria of objective research (70% acceptance level and 60/40 preference level).

In this work was developed and tested recipes for new high quality products based on mixtures of pressed and squeezed fruit without adding preservatives, stabilizers or chemical correctors of pH and acidity.

REFERENCES

Ankit Patras, Nigel P. Brunton, Sara Da Pieve, Francis Butler, 2008. Impact of high pressure processing on total antioxidant activity, phenolic, ascorbic acid, anthocyanin content and colour of strawberry and blackberry purées. Innovative Food Science and Emerging Technologies 10 (2009) 308–313

Derek F. Keenan, Nigel P. Brunton, T. Ronan Gormley, Francis Butler, Brijesh K. Tiwari, Ankit Patras, 2009. Effect of thermal and high hydrostatic pressure processing on antioxidant activity and colour of fruit smoothies. Innovative Food Science and Emerging Technologies 11 (2010) 551–556

I. Palgan, A. Muñoz, F. Noci, P. Whyte, D.J. Morgan, D.A. Cronin, J.G. Lyn, 2011. Effectiveness of combined Pulsed Electric Field (PEF) and Manothermosonication (MTS) for the control of Listeria innocua in a smoothie type beverage. Food Control 25 (2012) 621e625

Jonathan Mosqueda-Melgar, Rosa M. Raybaudi-Massilia, Olga Martín-Belloso, 2011. Microbiological shelf life and sensory evaluation of fruit juices treated by high-intensity pulsed electric fields and antimicrobials. Food and bioproducts processing 9 0 (2 0 1 2) 205–214

L. Espinosa-Muñoz, R. Symoneaux, C.M.G.C. Renard, N. Biau, G. Cuvelier, 2011. The significance of structural properties for the development of innovative apple puree textures. LWT - Food Science and Technology 49 (2012) 221e228, journal homepage: www.elsevier.com/locate/lwt

Lars Müller, Susanne Gnoyke, Anne M. Popken, Volker Bo¨hma, 2009. Antioxidant capacity and related parameters of different fruit formulations, LWT - Food Science and Technology 43 (2010) 992–999, journal homepage: www.elsevier.com/locate/lwt

Markus Walkling-Ribeiro, Francesco Noci, Denis A. Cronin, James G. Lyng, Desmond J. Morgan, 2009. Shelf life and sensory attributes of a fruit smoothie-type beverage processed with moderate heat and pulsed electric fields. LWT - Food Science and Technology 43 (2010) 1067e1073

Raffaella Di Cagno, Giovanna Minervini, Carlo G. Rizzello, Maria De Angelis, Marco Gobbetti, 2011. Effect of lactic acid fermentation on antioxidant, texture, color and sensory properties of red and green smoothies. Food Microbiology 28 (2011) 1062e1071

Sonia Calligaris, Martina Foschia, Ingrid Bartolomeoli, Michela Maifreni, Lara Manzocco 2010. Study on the applicability of high-pressure homogenization for the production of banana juices. LWT - Food Science and Technology 45 (2012) 117e121, journal homepage: ww.elsevier.com/locate/1w

Espinosa-Muñoz a,b,e,*, R. Symoneaux c, C.M.G.C. Renard d, N. Biau e, G. Cuvelier a,b, (2011), The significance of structural properties for the development of innovative apple puree textures, LWT-Food Science and Technology 49 (2012) 221e228, journal homepage: www.elsevier.com/locate/lwt

Lars Mu¨ ller a, Susanne Gnoyke a, Anne M. Popken b, Volker Bo¨hma,* (a Institute of Nutrition, Friedrich Schiller University Jena, Dornburger Strabe 25-29, 07743 Jena, Germany; b Eckes-Granini Group Deutschland GmbH, Ludwig-Eckes-Allee 6, 55268 Nieder-Olm, Germany), Antioxidant capacity and related parameters of different fruit formulations, LWT-Food Science and Technology 43 (2010) 992–999, journal homepage: www.elsevier.com/locate/lwt

Markus Walkling-Ribeiro*, Francesco Noci, Denis A. Cronin, James G. Lyng, Desmond J. Morgan, Shelf life and sensory attributes of a fruit smoothie-type beverage processed with moderate heat and pulsed electric fields, 2009, LWT-Food Science and Technology 43 (2010) 1067e1073

Raffaella Di Cagno*, Giovanna Minervini, Carlo G. Rizzello, Maria De Angelis, Marco Gobbetti, Effect of lactic acid fermentation on antioxidant, texture, color and sensory properties of red and green smoothies, 2011, Food Microbiology 28 (2011) 1062e1071

Sonia Calligaris*, Martina Foschia, Ingrid Bartolomeoli, Michela Maifreni, Lara Manzocco (2010), Study on the applicability of high-pressure homogenization for the production of banana juices, LWT-Food Science and Technology 45 (2012) 117e121, journal homepage: ww.elsevier.com/locate/1w