STUDY CONCERNING THE INFLUENCE OF ANY EDULCORANTS ON LEMON JUICE COMPOSITION

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Key Words: edulcorants, lemon juice, changed chemical composition

Abstract: The lemon juice is very important for his variety chemical composition: lot of hydro soluble vitamins (especially Ascorbic Acid), potassium, phosphorus, riboflavin. It is through, this composition is normally for the unsweetened lemon juice; the sweetened lemon juice prove the different chemical composition depend by the used edulcorants.

The work paper- part from a great study regarding the behaviour of edulcorants in to foods - shows the results from a study concerning the influence of edulcorants on lemon juice composition.

INTRODUCTION

The exact origin of the lemon has remained a mystery, though it is widely presumed that lemons are wildly grown in both India and China. It is also speculated that lemons were first grown on Mediterranean bushes, coined lemon bushes, but they have evolved and modern-day lemons grow on trees. In South and South East Asia, it was known for its antiseptic properties and it was used as antidote for various poisons. The lemon was later introduced to Iraq and Egypt around 700 A.D. [Wright, A.C.]

The popular drink lemonade may have originated in medieval Egypt. It was distributed widely throughout the Arab world and the Mediterranean region between 1000 A.D. to 1150 A.D. At this time, the lemon was first recorded in literatures to a tenth century Arabic treatise on farming and was used as an ornamental plant in early Islamic gardens. Lemon juice, fresh, canned, concentrated and frozen, or dehydrated and powdered, is primarily used for lemonade, in carbonated beverages, or other drinks [www.limmi.it].

Lemon juice is widely known as a diuretic, antiscorbutic, astringent, and febrifuge. In Italy, the sweetened juice is given to relieve gingivitis, stomatitis, and inflammation of the tongue. Lemon juice in hot water has been widely advocated as a daily laxative and preventive of the common cold, but daily doses have been found to erode the enamel of the teeth. Prolonged use will reduce the teeth to the level of the gums. Lemon juice and honey, or lemon juice with salt or ginger, is taken when needed as a cold remedy.[www.middlepath.com.au].

Citrus juices (especially lemons juice) are heat-treated to inactivate the endogenous pectin esterase, which would otherwise provide pectic acid which can aggregate and flocculate in the presence of Ca$^{2+}$ ions. However, since heat treatment damages fruit aroma, the use of polygalacturonase is preferred. This enzyme degrades the pectic acid to such an extent that flocculation does not occur in the presence of divalent cations [Belitz E].
Table 1 - Food Value per 100 g of Edible Portion* [www.hort.purdue.edu]

<table>
<thead>
<tr>
<th></th>
<th>Fruit (fresh, peeled)</th>
<th>Juice (fresh)</th>
<th>Juice (canned, unsweetened)</th>
<th>Juice (frozen, unsweetened)</th>
<th>Lemonade (concentrate, frozen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>27</td>
<td>25</td>
<td>23</td>
<td>22</td>
<td>195</td>
</tr>
<tr>
<td>Moisture</td>
<td>90.1 g</td>
<td>91.0 g</td>
<td>91.6 g</td>
<td>92.0 g</td>
<td>48.5 g</td>
</tr>
<tr>
<td>Protein</td>
<td>1.1 g</td>
<td>0.5 g</td>
<td>0.4 g</td>
<td>0.4 g</td>
<td>0.2 g</td>
</tr>
<tr>
<td>Fat</td>
<td>0.3 g</td>
<td>0.2 g</td>
<td>0.1 g</td>
<td>0.2 g</td>
<td>0.1 g</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>8.2 g</td>
<td>8.0 g</td>
<td>7.6 g</td>
<td>7.2 g</td>
<td>51.1 g</td>
</tr>
<tr>
<td>Fibber</td>
<td>0.4 g</td>
<td>trace</td>
<td>trace</td>
<td>trace</td>
<td>0.1 g</td>
</tr>
<tr>
<td>Ash</td>
<td>0.3 g</td>
<td>0.3 g</td>
<td>0.3 g</td>
<td>0.2 g</td>
<td>0.1 g</td>
</tr>
<tr>
<td>Calcium</td>
<td>26 mg</td>
<td>7 mg</td>
<td>7 mg</td>
<td>7 mg</td>
<td>4 mg</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>16 mg</td>
<td>10 mg</td>
<td>10 mg</td>
<td>9 mg</td>
<td>6 mg</td>
</tr>
<tr>
<td>Iron</td>
<td>0.6 mg</td>
<td>0.2 mg</td>
<td>0.2 mg</td>
<td>0.3 mg</td>
<td>0.2 mg</td>
</tr>
<tr>
<td>Sodium</td>
<td>2 mg</td>
<td>1 mg</td>
<td>1 mg</td>
<td>1 mg</td>
<td>0.2 mg</td>
</tr>
<tr>
<td>Potassium</td>
<td>138 mg</td>
<td>141 mg</td>
<td>141 mg</td>
<td>141 mg</td>
<td>70 mg</td>
</tr>
<tr>
<td>Thiamine</td>
<td>0.04 mg</td>
<td>0.03 mg</td>
<td>0.03 mg</td>
<td>0.03 mg</td>
<td>0.02 mg</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>0.02 mg</td>
<td>0.01 mg</td>
<td>0.01 mg</td>
<td>0.01 mg</td>
<td>0.03 mg</td>
</tr>
<tr>
<td>Niacin</td>
<td>0.1 mg</td>
<td>0.1 mg</td>
<td>0.1 mg</td>
<td>0.1 mg</td>
<td>0.3 mg</td>
</tr>
<tr>
<td>Ascorbic Acid</td>
<td>53 mg</td>
<td>46 mg</td>
<td>42 mg</td>
<td>44 mg</td>
<td>30 mg</td>
</tr>
</tbody>
</table>

*Analyses of true lemons, as marketed.

Like as show from the table, the lemon processing has more effects from the original lemon fruit composition: more compounds concentration is decreased (proteins, fat, fibbers, iron, and calcium). After use the natural or synthesis edulcorants the lemon juice composition will be changed and this change can be proved using the UV-Vis spectroscopy (like as cheapest analysis method). The new effects create by the new lemon sweetened juice are today not descript but we can considered that the best edulcorant for lemon juice is the edulcorants that induce the minimally effects than unsweetened lemon juice (prove through the changes of molecular spectra curves for the sweetening variants pertain to simile molecular spectra curves for unsweetening variant).

MATERIAL AND METHODS

For to quantify the sights of a changed juice composition on sweating task with natural and synthetic’s edulcorants it is constituted nine experimental variants.

From unsweetened variant of natural lemon juice V0 it is obtained through sweetness task the follow experimental variants:
- V0 – the unsweetened variants of natural lemon juice,
- V1 – the sugar sweetened variant of natural lemon juice,
- V2 – the honey sweetened variant of natural lemon juice,
- $V_3$ – the saccharine sweetened variant of natural lemon juice,
- $V_4$ - the natural glucose sweetened variant of natural lemon juice,
- $V_5$ – the variant of natural lemon juice that has been sweetened with Flix,
- $V_6$ – the variant of natural lemon juice that has been sweetened with Equal,
- $V_7$ – the variant of natural lemon juice that has been sweetened with Clio,
- $V_8$ – the variant of natural lemon juice that has been sweetened with Edulciclam,
- $V_9$ – the variant of synthesis lemon juice.

The used sugar for $V_1$ have proved a concentration of 2.50g/50mL natural lemon juice concentration. The sodium saccharine has proved in to $V_3$ a 25 mg/50mL natural lemon juice and the longer solvated time. The used honey for the $V_2$ has 4g/50mL and it is from acacia honey type. Honey made by bees using the acacia flower as forage is considered a delicacy, appreciated for its mild flowery taste, soft running texture and glass-like appearance. Acacia honey is one of the few honeys which does not crystalize. For the $V_4$ it was used the pharmaceutical natural glucose (5%) obtained though the separation-concentration task.

For to obtain the $V_5$ was used Flix (one pills was composed by lactose 1mg, saccharine 8mg, aspartame 3mg, excipients E468 and E641). Equal was a synthetic edulcorants (with aspartame) and was used for $V_6$.

Edulciclam was a synthetic sweetener (sodium cyclamate) and was proved a 25mg/50mL natural lemon juice into $V_8$.

The synthesis lemon juice was constituted by: citric acid E330, maltodextrine E140, sodium cyclamate E952, sodium saccharine E954, aspartame E951, ascorbic acid E300, tartrazine E102, the lemon flavour, and was constituted the $V_9$.

The „Clio” contain the sodium cyclamate (57.8%), saccharine (15.5%), sodium bicarbonate (13.7%), mono-sodium citric acid (13%) and was used for $V_7$.

The samples were cleaned (for the interference substances) and were spectrophotometered in the nearly UV, VIS and nearly IR ranges. The variations of molecular absorption spectra were recording in report by the wave-length. Then, these molecular absorption spectra were analysed, help by the statistical soft „SPSS for Windows 11.0”, the deviation from linearity of the base variant, the partial coefficient of correlation, the analysis of the mean square for the obtain data-establishing mathematic what is the best sweetening variant for the natural lemon juice.

Before the spectrometry task the samples were prepared in the same conditions of temperature, pressure and for spectrometry task it used an digital spectrophotometer UNICAM 2 UV-Vis, with 1cm cuvette broad and the automatically change of deuterium lamp with tungsten lamp at 325nm (this mechanism was set up before analysis).

For decreasing the limits of errors, the obtained results were replayed in to automatically retracking and save in to files .qnt format. The final data were converted with the soft Visio ver.2.0. For to evident any errors of preparing the samples generate by human or research equipment the sensitivity field of equipment was increased and the software for digital spectrophotometer was correlate upgrade. That generate an increased precision for the analyses and the absorption spectra range was expanded. Any error of prepare the sample can be detect fast and can be easy corrected. This method was purposed for to patent.

RESULTS AND DISCUSSIONS

After the process of spectrophotometry on those three ranges, it were obtaining more then 900 pairs of data that were statistic prepared-result after the statistical data analysis. After these, the sweetening natural variant with glucose was the best for the natural lemon
juice, the Pearson correlation being the only of 1,000 in the follow pair of variant unsweetened / with glucose comparing to the other pairs.

For simplify the procedures in this work paper it is showed the best sweetened variants with natural and synthetic edulcorant and the bad sweetened variant – for natural lemon juice.

Figure 1 - The variation of molecular absorption spectra for unsweetened natural lemon juice in to near UV domain (190-300 nm)

Figure 2 - The variation of molecular absorption spectra for natural lemon juice in to near UV domain (190-300 nm) with natural glucose
Figure 3 - The variation of molecular absorption spectra for natural lemon juice in to near UV domain (190-300 nm) with Edulciclams (sodium cyclamate)

Figure 4 - The variation of molecular absorption spectra for natural lemon juice in to near UV domain (190-300 nm) with Honey

From analyse of molecular absorption spectra curve, glucose (used in to V₄) – like natural sweetener – was the best natural sweetener. Glucose has produce the minimum the deviation from the molecular absorption spectra curve specify for the unsweetened natural lemon juice (cf. fig. 1 and 2).
From lot a used synthetic edulcorants, for prepare the natural lemon juice; the best edulcorants was Edulciclame (sodium cyclamate) (cf.fig.3).

Thanks to terpenes from lemon juice (especially limonene) [Leonte M, Florea T.], honey – like as used edulcorants form varieties compounds and the molecular absorption spectra curve was more different from the basic curve (cf.fig.4).

CONCLUSIONS

The method of analysis that use the UV VIS spectrometry can be a good and cheaper method of analyse than HPLC methods for determinate the concentration and effect of sweeteners, the UV- VIS optical methods can be used for to determinate the best edulcorants for the natural lemon juice and can be complete with FTIR spectrometry (for analysis the any isomers derivate from compounds of base);

For the natural lemon juice and for the any thermal solvated conditions the natural glucose ($V_4$) was the best natural edulcorant, the curve of the molecular absorption spectra (especially in to near UV range) for this sweetener has showed the minimum changes from the basis curve of the molecular absorption spectra for unsweetened natural lemon juice;

The more changes of molecular absorption spectra were registered in to honey case ($V_2$), this edulcorant can turbid the lemon juice and produced the Maillard and Strecker compounds. The acacia honey can strong oxidize the lemon juice media and can produce more another unknowing compounds;

For the people that have some digestive aches or cardiac problems, who cannot use sugar in there consumption, they have an alternative with Edulciclame (sodium cyclamate).

BIBLIOGRAPHY