Advance Journal of Food Science and Technology 15(SPL): 143-147, 2018
DOI:10.19026/ajfst.15.5886
ISSN: 2042-4868; e-ISSN: 2042-4876

Submitted: September 14, 2017 Accepted: December 9, 2017 Published: July 10, 2018

Research Article

Development of Energy Drinks with Orange Juice (*Valencia frost)*

Carlos Julio Márquez Cardozo, Daniela Molina Hernández and Jairo Alexander Osorio Saráz
Faculty of Agricultural Sciences, Universidad Nacional de Colombia, Calle 59A No 63-20, Postal Code: 050034, Medellín, Colombia

Abstract: The aim of this study was developed an energy orange juice drink with an addition to caffeine and taurine. For that, comparison of means tests were performed for four treatments, corresponding to juice added with caffeine 0.032% concentration, juice added with taurine 0.4% concentration, juice added with caffeine and taurine mixture 0.032% and 0.4%, respectively and one control, each with six replicates. The drinks were packed in low density polyethylene bags and stored at 4°C. The soluble solids (°Bx), pH, acidity, expressed as the percentage of citric acid, instrumental color and browning index and sensory characteristics (color, odor, appearance and taste) were evaluated at 0, 5, 10, 15, 20, 25 and 30 days. All the evaluated beverages presented suitable conditions for the consumption until the day 30, in addition, the added caffeine and taurine mixture treatment was which presented the best sensorial characteristics (appearance, color, odor and flavor). The acidity of all treatments increased during storage, is the largest increase for taurine treatment that was 1.37% to 2.1%, the pH decreased from 3.3 to 3.2 for all treatments except the Control; and soluble solids remained constant. In addition, the energizing agents did not affect the goldenness index of the beverages.

Keywords: Caffeine, citrus, physical-chemical characteristics, sensory evaluation, taurine

INTRODUCTION

Colombia shows a dynamic and interesting participation in the orange production international context (Suárez Garcia, 2011). World citrus production centers in Brazil as the first producer, followed by the United States and India. Fresh citrus global trade is low compared to production, revealing high domestic consumption in producing countries, as well as agroindustrial processing (Szita *et al*., 2012).

The orange importance lies in its high antioxidants content, substances capable of blocking the damage of free radicals caused by tobacco, some harmful chemicals, pollution, among others, thus prevent chronic and degenerative diseases such as cancer (Harborne, 1988). In the same way, it is notable for its vitamin C contribution, which is not generated by the body and indispensable for good health (Szita *et al*., 2012). Energy drinks are over-the-counter products, promoted as a way to relieve fatigue, maintain alertness, improve physical performance and stimulate cognitive abilities in stress situations (Itany *et al*., 2014).

They are usually composed of carbohydrates, taurine, caffeine, guarana, ginseng and thiamin. They contain B vitamins and vitamins C and E (Hincapié Llanos *et al*., 2012). Figure 1 shows the molecular structure of Taurine.

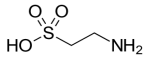

Fig. 1: Molecular structure of amino acid taurine

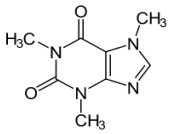

Fig. 2: Caffeine molecule

Taurine is a common ergogenic supplement that is produced naturally by the body (Mejía *et al*., 2008). However, this amino acid is produced by the methionine and cysteine metabolism, important in multiple metabolic processes, such as osmoregulation, antioxidation and glycolysis (Klepacki, 2010). Figure 2 presents the molecular structure of caffeine.

Caffeine produces a generalized Central Nervous System (CNS) activation, possibly by increasing noradrenaline release (Melgarejo, 2004). It increases alertness, reduces the tiredness sensation, raises the capacity to maintain an intellectual effort and maintains the state of wakefulness in spite of sleep deprivation (Pardo Lozano *et al*., 2007). Chemically, caffeine, like theophylline and theobromine, belong to the group of

Corresponding Author: Carlos Julio Márquez Cardozo, Faculty of Agricultural Sciences, Universidad Nacional de Colombia, Calle 59A No 63-20, Postal Code: 050034, Medellín, Colombia

compounds that constitute methylxanthines (Cote-Menéndez *et al*., 2011). Because of their similarity to purines bind to adenosine receptors, acting as competitive antagonists, resulting in an inhibition of phosphodiesterase which results in an increase in the concentrations of cyclic Adenosine Monophosphate (cAMP), a nucleotide that functions as a second messenger in several biological processes, promoting an activation of neurotransmitters through activation of K^+ channels and inhibition of channels Of calcium (Pardo Lozano *et al*., 2007).

The investigation objective was formulated and develops fresh orange juice energy drinks, with caffeine and taurine-caffeine and taurine addition, stored at 4°C±1 for 30 days.

MATERIALS AND METHODS

Material: Orange fruits (Valencia frost) harvested in the Arma district, belonging to the Municipality Aguadas, Caldas Department (Colombia), in the consumption ripe stage was collected and transported to the Fruit and Vegetables and Quality Control of Food Laboratories from the National University of Colombia, Medellin. The oranges were selected by external appearance, with a caliber between 84 to 92 mm, orange and some with light green visions, weight between 80 and 150 g with 10.9±1.1 average solids content expressed as degrees Brix (°Bx),in accordance with Colombian Technical Standard NTC 4086. 100 mL was packed in 42 bags of low density polyethylene for each treatment, for four treatments, with a total of 168 Experimental Units (U.E.), 0, 5, 10, 15, 20, 25 and 30, six U.E. per evaluation day, for a total of 24 energy drinks evaluated per day. The experiment was performed in triplicate and the results were presented as mean plus minus 5% error, for the evaluation time was 30 days stored samples at the refrigeration temperature of 4°C±1.

Energy drinks formulation and development: The fruits were washed and disinfected by 50 ppm sodium hypochlorite immersion for 15 min (Peña *et al*., 2012). Then the juice was extracted from the oranges with an Oster® 3157-012 instrument, 3200 caffeine per 100 mL of orange juice, equivalent to 0.032%, was added for to 4,200 mL, with a total of 1.34 g of caffeine grade reagent Belchem® brand. The second treatment consisted of adding 400 mg taurine per 100 mL of orange juice, equivalent to 0.4%, adding a total of 16.8 g taurine grade reagent Belchem® brand. The third treatment consisted of adding both energizing agents in 0.032% and 0.4% of caffeine and taurine proportions respectively, for the 4,200 mL of juice, both treatments and control (without caffeine or taurine addition) was added 0.1% of benzoate Sodium as the preservative. All treatments and control were packed in 100 mL portions in polyethylene bags of low density caliber 3 and stored in refrigeration.

Browning index: The effect of caffeine and taurine addition on the browning index of the formulated energy drinks was determined by the evaluation of the color tristimulus parameters from the CIE L*a*b* coordinates, where "L" corresponds to the brightness with a 0 to 100 scale, "a" refers to the range of colors between green and red and "b" represents the range of colors between blue and yellow, using a spectrophotometer model SP64, X-RITE inc., MI, USA Of sphere with illuminant D 65 and an 10° observe angle. Measurements were made at six U.E. For each treatment per evaluation day. The Index of Browning (BI) was calculated by Eq. (1) and (2), which represents an affectation of the color of the drink indicator and is related to the enzymatic activity of the polyphenol oxidase:

$$BI = \frac{[100(X-0{,}31)]}{0{,}17} \quad (1)$$

where,

$$x = \frac{(a* + 1{,}75L*)}{(5{,}645L* + a* - 3{,}012b*)} \quad (2)$$

(Maskan, 2001)

Measurement of soluble solids, acidity and pH: The acidity was determined from acid-base titration with 0.1 N NaOH and phenolphthalein as indicator. For the pH was measured potentiometrically using a Schott CG-840B digital pH meter. Soluble solids were measured by refractometry using a Leica Abbe scale with 0 to 32° Brix scale (Márquez-Cardozo *et al*., 2017).

Sensory evaluation: Was performed every 5 days for 30 days. Sensory tests were carried out by nine semi-trained judges who were aware of the organoleptic characteristics of orange juice, by numerical evaluation of the attributes of appearance, color, odor and taste (Márquez *et al*., 2009). The drinks conditions for the performance of test performance by the judges were at refrigeration temperature between 5 and 7°C, for each treatment and evaluation time. The drinks were served to the judges in equal vessels and the samples were coded with three random digits and without any order of position, to qualify the different sensory attributes. The scores to be assigned to the samples were according to the following rating.

Appearance: 4 to 3.5. Homogeneous appearance, the minimal presence of skin pieces, seeds or other defects. 3.4 to 2.6. Moderate presence of foreign material 2.5 Or less. Unpleasant appearance, too much presence of foreign material

Color: 4 to 3.5 Characteristic color of fresh, homogeneous and bright orange juice 3.4 to 2.6

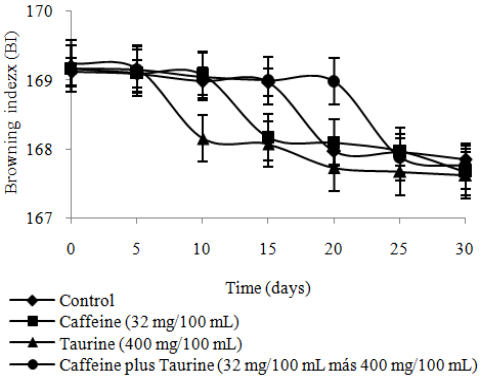

Fig. 3: Evolution of the browning index over time of orange juice (*Valencia frost*) energy drinks stored at 4°C±1 for 30 days

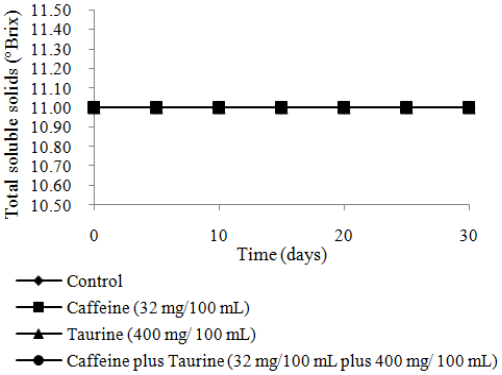

Fig. 4: Soluble solids (°Brix) of energy drinks made from orange juice (*Valencia frost*) stored at 4°C±1 for 30 days

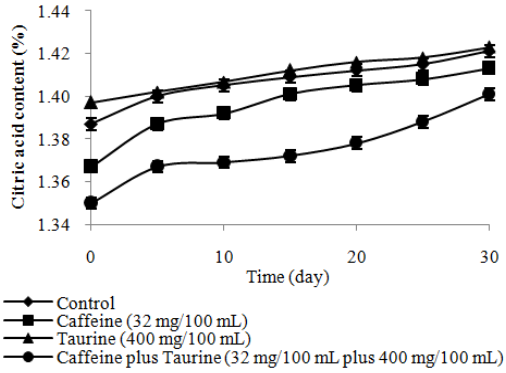

Fig. 5: Variation of acidity percentage of orange juice (Valencia frost) energy drinks stored at 4°±1 for 30 days

Minimal color variations, not homogeneous 2.5 Or less. Color very different from the normal orange juice

Odor: 4 to 3.5. Characteristic odor of fresh and very intense orange juice 3.4 - 2.6. Characteristic odor of fresh but not very intense orange juice 2.5 Or less. Minor odor, fermented odor, other strange odors

Flavor: 4 to 3.5 Characteristic taste of fresh fruit, suitable sweet acid balance 3.4 to 2.6 Minimum presence of some strange taste 2.5 Or less. Accented strange taste, minimal taste of fresh orange juice

Statistic analysis: A completely randomized experimental design was used, with a factorial arrangement 4×7, where 4 corresponds to the treatments and 7 to the evaluation periods in time, the experiment was performed in triplicate. Analysis of variance, standard error and analysis of the means was applied using the statistical Statgraphics plus program.

RESULTS AND DISCUSSION

Browning index: Figure 3 shows a slight change in the browning index of the orange juice energy drinks between day 0 and day 5, after this time the browning index of the beverages showed a relatively constant decrease, The treatment that presented better color and lower browning index was treatment 3 (32 mg of caffeine+400 mg of taurine per 100 mL of juice), probably because of the taurine and caffeine chemical composition that stabilizes the pigments Carotenes from orange juice and thus control the browning, In addition for this type of reactions to occur, the presence of oxygen is necessary which is inhibited by the packing in the polyethylene bag and the storage in the cooling room. Color changes are one of the organoleptic characteristics that define the quality and acceptability of fruit products. The development of brown pigments due to enzymatic browning reactions is one of the major problems associated with the processing of these products, therefore there are substances that inhibit these reactions and it is probable that the energizing agents used in this investigation have fulfilled this study (Baisier and Labuza, 1992).

Measurement of soluble solids, acidity and pH: Figure 4 shows the soluble solids concentration during the 30 days of evaluation, it is clear that they were kept constant, which indicates that the proliferation of microorganisms that could use the beverages carbohydrates as a substrate to generate fermentation and alter the Physical-chemical and sensory characteristics of the same, it is probable that the energizing agents combined with the addition of the chemical coservante potentiate the inhibitory effect of the development of microorganisms, which is in agreement with the found by other researchers for energizing drinks with the addition of caffeine (Márquez-Cardozo *et al*., 2017).

Figure 5 shows the behavior of the percentage of acidity over the measurement time. In citrus drinks the degree of acidity indicates the content of free acids; Which is used as a quality parameter; Through the

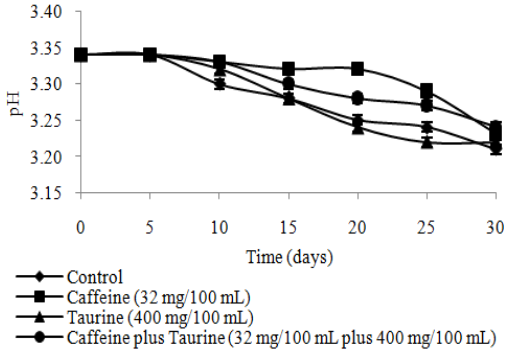

Fig. 6: pH of orange juice (*Valencia frost*) energy drinks stored at 4°C±1 for 30 days

determinations of the acid value or the Acid Value (V.A.) present in them (Barón and Vlla, 2013).

It is evident that the percentage of acidity compared to day zero increased for all the treatments, also that the highest acidity percentage at the end of the evaluation was for the control samples so that taurine and caffeine could be a component that inhibits the increase of acidity in the beverage. For the specific samples, to which 32 mg of caffeine and 400 mg of taurine was added, they had a minimum acidity increase compared to the initial one.

Figure 6 shows the variation of pH over the measurement time, thus, is evident that the pH of the beverage increased slightly in the control compared to the initial day, however the variation was minimal for the samples added with taurine and caffeine energizers, aspect that can confer a buffer effect or pH regulator to these agents. Could be said that the pH remained relatively stable throughout the evaluation period.

Sensory evaluation: Figure 7A shows the change in appearance, it is observed that for the 30 days, it remained constant, so did not present any chunks or seeds, therefore, the judges awarded it the highest mark. Figure 7B shows the color variation, it is observed that the sensorial quality decreased slightly compared to the initial day, a more noticeable change occurred the color of the control with respect to the drinks added with energizing agents, an aspect that could be related to chemical reactions properties that stabilize the pigments of the carotene type present in orange juice, especially by the sulfur groups present in taurine.

Figure 7C shows the change in the aroma of the beverage, a reduction of the odor is observed, but in a mild way, in general, the aroma of the beverage remained (concentrated and with the orange juice characteristic smell).

Figure 7D presents the results of the taste of the beverage through time. A slight change in this sensorial attributes is observed, especially for the control and the caffeine treatment, showing significant difference compared to the taurine and the one added with caffeine and taurine treatments, the previous one probably due to normal reactions of deterioration of fresh juices

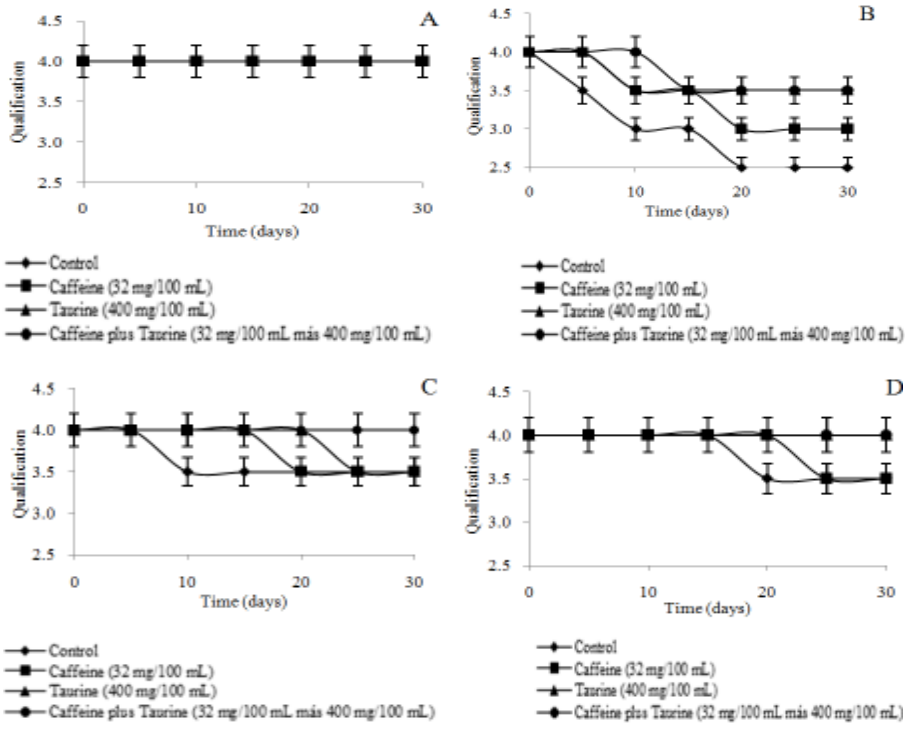

Fig. 7: Appearance (A), color (B), aroma (C) and flavor (D) of energy drinks based on orange juice (*Valencia frost*) stored at 4°C±1 for 30 days

without heat treatment that retain the possibility of oxidation of some of its molecules, in addition to any enzymatic actions that can influence the taste, can be evidenced by a slight but notorious acidity increase in the last days. This can also be contrasted with the pH change.

CONCLUSION

Energy orange juice added with caffeine and taurine at 32 ppm and 400 ppm concentration stored for 30 days at 4°C presented sensory conditions of flavor, odor, color and appearance suitable for human consumption and showed a browning index similar to control.

The acidity for all treatments increased during the 30 days of storage being higher for the control.

The pH of the beverages decreased compared to the initial day, for the treatments and for the control.

For all the treatments a slight decrease in the color intensity was shown, however the more affected was the one without adding, of energizing substances corresponding to the control.

ACKNOWLEDGMENT

To the laboratory of fruits and vegetables of the National University of Colombia Sede Medellín and the laboratory technician.

CONFLICT OF INTEREST

The authors declare that there is no interest conflict.

REFERENCES

Baisier, W.M. and T.P. Labuza, 1992. Maillard browning kinetics in a liquid model system. J. Agr. Food Chem., 40(5): 707-713.

Barón, R.D. and A.L. Vlla, 2013. Evolución de los parámetros de calidad de naranja valencia producida en el municipio de Chimichagua, Cesar-Colombia. Temas Agrarios, 18(1): 66-74.

Cote-Menéndez, M., C.X. Rangel-Garzón, M.Y. Sánchez-Torres and A. Medina-Lemus, 2011. Bebidas energizantes: ¿Hidratantes o estimulantes? Rev. Fac. Med., 59(3): 255-266.

Harborne, J.B., 1988. The Flavonoids: Advances in Research Since 1980. 1st Edn., Chapman and Hall, London, New York, 2: 525-536.

Hincapié Llanos, G.A., J.C. Palacio Piedrahíta, S. Páez Sierra, C.E. Restrepo Flórez and L.M. Vélez Acosta, 2012. Elaboración de una bebida energizante a partir de borojó (*Borojo apatinoi* Cuatrec.). Rev. Lasallista Invest., 9(2): 33-43.

Itany, M., B. Diab, S. Rachidi, S. Awada, A. Al Hajje, W. Bawab and P. Salameh, 2014. Consumption of energy drinks among lebanese youth: A pilot study on the prevalence and side effects. Int. J. High Risk Behav. Addict., 3(3): e18857.

Klepacki, B.M.S., 2010. Energy drinks: A review article. Strength Cond. J., 32(1): 37-41.

Márquez, C.J.C., V.J.R. Cartagena and MB. Pérez-Gago, 2009. Effect of edible coatings on japanese loquat (*Eriobotrya japonica* T.) postharvest quality. Vitae, 16(3): 304-310.

Márquez-Cardozo, C.J., C.A. Jiménez Castañeda and C. S. Salazar Ripoll, 2017. Development of mango (*Mangifera indica* L.) energy drinks. Rev. Fac. Nac. Agron., 70(1): 8115-8121.

Maskan, M., 2001. Kinetics of colour change of kiwifruits during hot air and microwave drying. J. Food Eng., 48(2): 169-175.

Mejía, O.M.A., C.F. Galvis-Pedrosa, H.A. Heredia-Mazuera and A. Restrepo-Pinzón, 2008. Efecto de las bebidas energizantes con base en taurina y cafeína sobre la atención sostenida y selectiva en un grupo de 52 adultos jóvenes entre 18 y 22 años de la ciudad de Bogotá. Rev. Iberoam. Psicol. Cienc. Tecnol., 1(1): 73-85.

Melgarejo, M., 2004. El verdadero poder de las bebidas energéticas. Rev. Enfasis Alim., 6(6): 2-4.

Pardo Lozano, R., Y. Alvarez García, D. Barral Tafalla and M. Farré Albaladejo, 2007. Cafeína: Un nutriente, un fármaco, o una droga de abuso. Adicciones, 19(3): 225-238.

Peña, R.L.F., G.B. Bernardo, G.J.A. Barrera and G.M.S. Hernández, 2012. Obtención de Pulpa de Asai (Euterpe Precatoria MART) en la Amazonía Norte Colombiana. Vitae, 19(1): S147-S149.

Suárez Garcia, G., 2011. Extracción de nutrientes por cosecha del cultivo de naranja (*Citrus sinensis*) variedad valencia en condiciones del Valle del Cauca. Ph.D. Thesis, Facultad de Ciencias Agropecuarias, Universito Nacional de Colombia Sede Palmira.

Szita, É., F. Kozár, J. Sierra, C.P. Pássaro Carvalho, C. Nunes, S.M. Vásquez Mejía and L. Palou, 2012. Cítricos: Cultivo, poscosecha e industrialización. 1(4): 7-23.