Advance Journal of Food Science and Technology 5(7): 871-873, 2013
DOI:10.19026/ajfst.5.3175
ISSN: 2042-4868; e-ISSN: 2042-4876

Submitted: March 13, 2013 Accepted: April 05, 2013 Published: July 05, 2013

Research Article

Concoction Optimization of a Functional Beverage Developed From Calligonum Linnaeus

Jianfeng Sun, Jie Wang, Weiqing Li, Xiaoru Wang and Xinyue Li
College of Food Science and Technology, Agricultural University of Hebei, Baoding, Hebei Province 071000, China
Engineering Technology Research Center for Processing of Agricultural Products of Hebei Province, Baoding 071000, China

Abstract: In this study, concoction technology of a functional beverage developed from Calligonum Linnaeus was investigated. The sensory evaluation, orthogonal test and variance analysis were used to study the processing technology. The result showed the best additive amounts were as follows: 0.08% malic acid and citric acid (1:1), 0.10% sodium cyclamate, 2.8% sucrose. Under aforementioned additive amounts, the obtained Calligonum Linnaeus beverage showed the best flavor and good palatability.

Keywords: Beverage, Calligonum Linnaeus, optimization

INTRODUCTION

In China, Calligonum Linnaeus was studied for food and medicinal use 1500 years ago Li *et al*. (2004) According to historical records, Calligonum contains inorganic salts, which is conducive to expand the body's blood volume and to dismiss hangover (Jiang *et al*., 2004; Editorial Board, 2010). Calligonum Linnaeus also contains large amounts of water, glucose, salts and organic lipids, which can promote urine excretion and gut motility. Calligonum contains vitamins and 18 essential amino acids, which can alleviate heat-producing factors and give the body added nutrients to enhance the body's resistance to disease; iron, phosphorus, calcium, copper, manganese, zinc as well as other trace elements and some alkaloids are also contained in Calligonum. These compositions are central inhibitive and anticonvulsant to prevent tetany spasm. Also, they have anti-lipid peroxidation effect and can decrease blood pressure (Yu *et al*., 2007). In addition, some study showed that the food processing nutritional deficiencies, environmental pollution and smoking, drug abuse and other behaviors can result in an increase of free radicals in the body which will damage the body's balance system (Buttke and Sandstrom, 1994; Aruoma, 1998; Peng *et al*., 2004). Our former research showed that Calligonum beverage had a high antioxidant activity (Sun *et al*., 2012), which expect to eliminate free radicals in human body. Orthogonal design and variance analysis are often used to optimize a technique process in many domains. (Annappa and Basavarajappa, 2013; Bagci and Imrek, 2013; Gao *et al*., 2012; Chuichulcherm *et al*., 2013; Hu *et al*., 2013).

In this study, malic acid, citric acid, sodium cyclamate and sucrose are used as concoction to developed a functional beverage. The concoction optimization process was carried out with sensory evaluation, orthogonal test and variance analysis. The obtained plant resource beverage showed co-ordination natural flavor and good palatability.

MATERIALS AND METHODS

Preparation of Calligonum Linnaeus extract: Calligonum Linnaeus was collected from the Yixian County of Hebei Province. After washing, 10 times distilled water was added and then heated to 100°C for 2-5 min. The processed liquid was natural cooling to 35°C and keeping for at least 9 h. Filtering the processed liquid with filter paper and then the Calligonum Linnaeus extract was obtained.

Concoction optimization process: In this test, the concoction optimization process was investigated. Malic and citric acid, sucrose and sodium cyclamate were used as deployment agency for concoction process, which were added into Calligonum Linnaeus extracts. Add appropriate amount of malic acid and citric acid with ratio of 1:1 to calligonum extract until the pH value reached 3-4. Add appropriate amount of sugar to Calligonum extract until the soluble solids content reaches about 4% and then add further amount of sodium cyclamate in the extract to achieve the right sweetness. And then after clarification and sterilization,

Corresponding Author: Jie Wang, College of Food Science and Technology, West Campus of Agricultural University of Hebei, No. 2596, Lekai South Street, Baoding, Hebei Province 071000, China, Tel.: +86-312-7528188

Table 1: Factor level table of orthogonal test

	Factor		
Level	A (Malic and citric acid/%)	B (Sodium cyclamate/%)	C (Sucrose/%)
S	0.04	0.06	1.8
2	0.08	0.10	2.8
3	0.12	0.14	3.8

the obtained beverage was tasted and estimated with sensory evaluation method.

According to the experience, there will be interaction between sugar and acid, therefor, the L_{27} (3^{13}) orthogonal test was employed. Table 1 shows the factors. The added amount of Malic and citric acid (malice acid and citric acid with ratio of 1:1) (A), sodium cyclamate (B) and sucrose (C) were used as factors. Each factor has three levels.

Flavor assessment: Flavor evaluation, such as color, taste and texture was carried out by a five-member panel using a 10-point hedonic scale according to Table 2. The sensory panel had been trained in sensory evaluation and had experience in the sensory testing of food products.

RESULTS AND DISCUSSION

The effect of malic and citric acid, sucrose, sodium cyclamate on the beverage flavor was shown in Table 3 and results of ANOVA were shown in Table 4. Table 4 showed that the malic acid and citric acid, sucrose, sodium cyclamate all had a very significant effect on the sensory score; the interaction of malic acid, citric acid and sodium cyclamate is also very significant and so as the interaction of malic acid, citric acid and sucrose.

Because the interaction of malic acid, citric acid and sodium cyclamate and the interaction of malic acid, citric acid and sucrose were both very significant.

Table 2: Sensory evaluation standards

Index		Grade	
Color (3points)	Brown <2.0	Yellow 2.1 to 2.4	Amber 2.5 ~ 3.0
Taste (4points)	Sour, too sweet<2.4	Slightly over-sweet and sour ,thin 2.5~2.9	Moderately sweet and sour, soft 3.0~4.0
Texture(3points)	Obvious turbidity or sedimentation<2.0	Clear, a little transparent, very little visible grain 2.0~2.4	Clear, transparent, no visible particles 2.5~3.0

Table 3: Effect of different additives on the sensory score of the orthogonal test

Treatment	A	B	(A×B)	A	C	(A×C)1	(A×C)2	(B×C)1	Empty columns	Empty columns	(B×C)2	Empty columns	Empty columns	Sensory score
1	1	1	1	1	1	1	1	1	1	1	1	1	1	7.5
2	1	1	1	1	2	2	2	2	2	2	2	2	2	7.0
3	1	1	1	1	3	3	3	3	3	3	3	3	3	5.8
4	1	2	2	2	1	1	1	2	2	2	3	3	3	6.8
5	1	2	2	2	2	2	2	3	3	3	1	1	1	9.3
6	1	2	2	2	3	3	3	1	1	1	2	2	2	5.8
7	1	3	3	3	1	1	1	3	3	3	2	2	2	5.8
8	1	3	3	3	2	2	2	1	1	1	3	3	3	8.5
9	1	3	3	3	3	3	3	2	2	2	1	1	1	5.0
10	2	1	2	3	1	2	3	1	2	3	1	2	3	8.3
11	2	1	2	3	2	3	1	2	3	1	2	3	1	8.0
12	2	1	2	3	3	1	2	3	1	2	3	1	2	7.3
13	2	2	3	1	1	2	3	2	3	1	3	1	2	7.0
14	2	2	3	1	2	3	1	3	1	2	1	2	3	9.8
15	2	2	3	1	3	1	2	1	2	3	2	3	1	7.9
16	2	3	1	2	1	2	3	3	1	2	2	3	1	6.3
17	2	3	1	2	2	3	1	1	2	3	3	1	2	8.8
18	2	3	1	2	3	1	2	2	3	1	1	2	3	8.3
19	3	1	3	2	1	3	2	1	3	2	1	3	2	7.8
20	3	1	3	2	2	1	3	2	1	3	2	1	3	4.5
21	3	1	3	2	3	2	1	3	2	1	3	2	1	5.3
22	3	2	1	3	1	3	2	2	1	3	3	2	1	7.5
23	3	2	1	3	2	1	3	3	2	1	1	3	2	7.6
24	3	2	1	3	3	2	1	1	3	2	2	1	3	7.3
25	3	3	2	1	1	3	2	3	2	1	2	1	3	5.8
26	3	3	2	1	2	1	3	1	3	2	3	2	1	7.3
27	3	3	2	1	3	2	1	2	1	3	1	3	2	6.0

Table 4: Table of ANOVA

Source of variance	SS	df	MS	F	Sig	Significance
A : Add of Malic acid and citric acid	8.416	2	4.208	19.030	0.001	**
B : Add of sodium cyclamate	9.947	2	4.973	22.492	0.001	**
C : Add of sucrose	4.007	2	2.003	9.060	0.009	**
A×B	8.204	4	2.051	9.276	0.004	**
A×C	11.778	4	2.944	13.317	0.001	**
B×C	1.487	4	0.372	1.681	0.246	
Error	1.769	8	0.221			
Total error	45.607	26				

Table 5: Interaction table of malic acid, citric acid (A) and sodium cyclamaten (B)

A/B	1	2	3
1	6.767	7.300	6.433
2	7.867	8.233	7.800
3	5.867	7.467	6.367

Table 6: Interaction table of malic acid, citric acid (A) and sucrose (C)

A/C	1	2	3
1	6.700	8.267	5.533
2	7.200	8.867	7.833
3	7.033	6.467	6.200

So it is necessary to relay on the interaction tables when chose suitable level factors. Table 5 is the interaction table of malic acid, citric acid and sodium cyclamate and Table 6 is the interaction table of malic acid, citric acid and sucrose.

It can be seen from Table 5 that the suitable level of malic acid and citric acid was A2 and the suitable level of sodium cyclamate is B2. And it can be seen from Table 6 that the suitable level of malic acid and citric acid was A2 and the suitable level of sucrose was C2. Therefore the appropriate combination of malic acid and citric acid, sodium cyclamate, sucrose addition is A2B2C2.That is to say, the suitable dosage of malic acid and citric acid was 0.08%; the suitable dosage of sodium cyclamate was 0.10%; the appropriate dosage of sucrose was 2.8%. This combination was No. 14 treatment in the orthogonal experiment, whose sensory score is 9.8, the highest for all treatments.

In this study, we provide a concoction optimization procrss of a functional beverage developed from Calligonum Linnaeus, which was believed that has the function of hangover. The process was optimize by Sensory evaluation method and Orthogonal Test. The result showed the best additive amount was as follows: 0.08% malic acid and citric acid (1:1), 0.10% sodium cyclamate, 2.8% sucrose. The process is simple and easy to be produced in the industry. Also, we believe that it has good prospects for market development.

ACKNOWLEDGMENT

This study was supported by grants of Science and Technology Project of Hebei Province, China (No. 11221004D), Science and Technology Project of Baoding City, Hebei Province, China (No. 09N03).

REFERENCES

Annappa, A.R. and S. Basavarajappa, 2013. Some studies on three body abrasive wear behavior of hard faced and normal plough tool material using taguchi method. Int. J. Surf. Sci. Eng., 7(1): 14-26.

Aruoma, O.I., 1998. Free radicals, oxidative stress and antioxidants in human health and disease. J. Am. Chem. Soc., 75: 199-212.

Bagci, M. and H. Imrek, 2013. Application of Taguchi method on optimization of testing parameters for erosion of glass fiber reinforced epoxy composite materials. Mater. Des., 46: 706-712.

Buttke, T.M. and P.A. Sandstrom, 1994. Oxidative stress as a mediator of apoptosis. Immunol. Today, 15(1): 7-14.

Chuichulcherm, S., S. Prommakort, P. Srinophakun and A. Thanapimmetha, 2013. Optimization of capsaicin purification from capsicum frutescens linn with column chromatography using taguchi design. Ind. Crop. Prod., 44: 473-479.

Editorial Board, 2010. Dictionary of Chinese Medicine. 1st Edn., Shanghai Science and Technology Press, Shanghai, pp: 205.

Gao, S.X., C.Y. Bao, G. Chao and Z.W. Li, 2012. The orthogonal test design and analysis for high additive fly ash firebrick. Appl. Mech. Mater., 174-177: 318-321.

Hu, J., G. Xueqin, C. Zhanchun, S. Kaizhi and D. Cong 2013. The effect of multiple variables on tensile property of injection-molded polypropylene through the combination of orthogonal design and variance analysis. J. Appl. Polym. Sci., 127(2): 1198-1202.

Jiang, Q.Z., S.G. Fu and X.B. Kuang, 2004. Utilization of hoeing dulcets. Jiangxi Forestry Sci. Technol., 6: 3.

Li, W.X., Z.G. He and X.Z. Lin, 2004. Research on wild calligonum processing. Fujian Fruit Trees, 3: 1-3.

Peng, Y.H., Y.W. Ceng and L.X. Xu, 2004. Antioxidant and health effects of flowers. J. South China Normal Univ., Soc. Sci. Edn., 2: 136-141.

Sun, J.F., J. Wang and W.Q. Li, 2012. Study on antioxidant activity of Calligonum beverage. Proceeding of the World Automation Congress, Puerto Vallarta, Mexico, pp: 1-6.

Yu, G., L.J. Wang and X.G. Cao, 2007. Polysaccharides extraction of orange dulcis and study of hangover function. Guangxi Light Ind., 10: 3.