Plant Archives Vol. 20, Special Issue (AIAAS-2020), 2020 pp. 110-113 *ISSN 0972-5210*

NUTRIENT COMPOSITION AND SENSORY EVALUATION OF WHEY BASED AMLA MARMALADE

Riya Shrivastava, Shubhra Saraswat* and Sneha V. Krishna
Department of Nutrition and Dietetics, Faculty of Applied Science, MRIIRS, Manav Rachna International University, Faridabad, India

Abstract

The objective of the present study was to elaborate amla marmalade by substituting 5% and 10% paneer whey. Physio chemical, sensory, microbial and texture analysis were performed on 0, 30th and 60th day of shelf life. Whey substitution significantly increased the protein content and acceptability of the test products. During the storage period, pH was decreased, acidity was increased but the changes were not significant. Reducing sugar of marmalade increased from 16.20 to 22.17 and non reducing sugars decreased from 45.18 to 40.28%. There was no microbial growth observed in all the samples during the storage period of 60 days. It was substantially proved that whey can be efficiently substituted in marmalade with advantage of improving it's nutritive, physio-chemical and organoleptic properties without any detrimental effect on sensory properties and also avoiding much denaturation of whey proteins.

Introduction

Marmalade is a popular and shelf stable product made from citrus fruits. Similar to jams and jellies, it is concentrated to achieve its gel like structure. It also contains fruit peels suspended there in it. Commercially available marmalades are generally good sources of energy but poor in protein content as reported from various brands. So there is a need to improve the protein content in marmalades to make it still a better nutritional food.

Indian gooseberry (*Emblica officinalis*) is a traditional and medicinal fruit with known nutritional benefits. It's a natural anti oxidant with the richest source of vitamin C (200-900 mg per 100g of edible portion) (Yadav *et al*., 2017). Numerous studies conducted on *Emblica officinalis* fruit suggest that it has anti viral properties and also functions as an anti-bacterial and anti-fungal agent. The gelatinous plum-sized Amla fruit contains naturally containing vitamin, heat stable vitamin C. A clinical study on patients with pulmonary tuberculosis showed that the vitamin C contained in *Emblica officinalis* was better assimilated than synthetic vitamin C. Further research of contemporary and traditional medical literature indicates that *Emblica officinalis* either in combination with other herbs or alone has been useful in the amelioration of colds, warts, skin infections, influenza, anemia, diabetes, lung condition, elevated cholesterol and as an immune restorative in cancer conditions. It's one of the best natural anti - ageing remedies. Amla is amazingly effective natural anti ageing product. It is very effective in treatment of acidity and peptic ulcers. Regular use of amla improves immunity, fight against cancers, chronic diseases like hypertension, high cholesterol, diabetes, influenza, chronic cough and cold, chronic infections, chronic fatigue and chronic inflammatory conditions. *Ayurveda* describes it as one of the best herbs for Diabetes, bleeding disorders, strength and stamina promoter (Asmawi, 1993; Zhang, 2003; Geetanjali, 2011).

Whey is a valuable byproduct obtained during manufacturing of cheese, Channa, casein, paneer and shreekhand as a watery portion of milk after coagulation and removal of curd. Whey contains about 50% of milk solids together with 100% of lactose and 20% of proteins (Siso, 1996). Whey protein is a complete high quality source of protein with a rich amino acid profile. Whey has a high protein efficiency ratio (Zhang, 2003; Renner, 1990), biological value (104) and net protein utilization (95), is next only to egg protein in terms of nutritive value (Renner, 1990). About 40% of total global production of whey is disposed as raw whey (Reddy, 1987) causing serious environmental pollution. The disposal of whey is problematic as the biological oxygen demand of whey is very high compared to domestic sewage (Mishra, 2009). So it's important to find alternative uses of whey to reduce the economic and environmental impact. Considering all the above factors, an attempt was made to develop whey based amla marmalade and sensory nutritional and microbial analysis were done for a period of 60 days.

Materials and Methods

Fully ripe healthy and fresh amla were procured from the local market. Plain condensed whey was obtained from Vita Milk Plant, Balabgarh, was stored in refrigerator for the development of the product. Methodology is shown in following Fig 1. 3 samples of amla marmalade were prepared by adding paneer whey. Control (C) without whey substitution, T1 5g substitution (5%) and T2 10g substitution (10%). Composition of the prepared marmalades is given in Table 1.

For substitution in marmalade, 30 minutes slow hydration was done by mixing plain condensed whey with water at 60˚C in the ratio of 1:2. Hydration improved the optimal performance of whey protein during heat processing (Zhang and Zhong, 2010). The pH of the marmalade was 3.31 to 3.08 and this pH helped in the stability of whey protein (beta-lactoglobulin) (Boye, 1996). Heat stability of whey protein was also improved by addding sucrose (Kulmyrzaev, 2000). Heating above 85˚C is critical for whey protein denaturation (Duranti, 1989). Hence, whey was added just 1-2

*Corresponding Author Email: shubhra.fas@mriu.edu.in

minutes before reaching the end point of marmalade preparation.

Chemical analysis

The prepared samples were analysed for moisture, ash, acidity, vitamin C, pH, Total Soluble Solids (TSS), Reducing sugar, Non-reducing sugar, total sugar, moisture and ash content adopting AOAC (2002) method (AOAC, 2002). Ranganna (1991) states the methods of reducing sugar and non-reducing sugar determination (Ranganna, 1991).

Microbial Analysis

Standard total plate count, score count, Coliform, yeast and mould count were performed on 0, 30th and 60th day of storage period for all the samples .

Sensory Evaluation

20 trained members for panel were selected and the samples were present for Hedonic Rating Test using the 9 point scale.

Statistical Data

Anova with Tukey's T test at 5% level was applied to compute the significant differences (STATISTICA 7.0).

Results and Discussion

Physico-chemical Analysis

Table 2 shows the chemical composition of the plain condensed whey and amla pulp before making the marmalade. Table 3 shows the Physico-chemical analysis of the different samples of marmalade developed for the study. The acidity value of all the marmalades range from 0.55-0.59 during the storage period of two months . Substitution of whey at 5% and 10% level didn't affect the acidity of the samples significantly. The total soluble solids of marmalades range from 66-69% in all the samples. Brix is the measure of all soluble solids from natural fruit components, added sugar, acid, pectin and other ingredients. For optimum gel formation with good texture and sensory acceptance the TSS should range between 65-68% (Macrae,1993; Damiani, 2008). Setting quality of marmalades can be improved by adequate pH maintenance. Substitution of whey didn't change the pH of the samples during 60 days and the ranges were 3.31 to 3.08. There was no significant rise in ash content of all the samples due to whey substitution. Ash content of all the samples ranged from 0.323% to 0.324% without any significant changes during storage. Akinyele *et al*. (1990) also reported the similar findings. Statistical analysis revealed that addition of whey significantly ($P<0.05$) increased the moisture content of T1 (28.74%) and T2 (30.32%) when compared with the control. This may be due to the higher water retention property of protein present in whey (Vidigal, 2012). Protein content of the tests samples were significantly different from the control due to whey substitution. Refined sucrose which has a tendency to recrystallise were used as sugar source. Statistical analysis revealed that substitution of whey significantly increased the reducing sugar content from 16.20% to 22.17%. This increase in reducing sugar content is due to the presence of reducing sugar lactose in whey (Jennes, 1959). The rise in reducing sugar has decreased non-reducing sugar content from 45.18% to 40.28% significantly. The results are similar with the studies done by Ewaidah, 1992 who observed the hydrolysis of sucrose increased in the reducing sugar content. Ascorbic acid in all the samples was found equal in all the samples because of the presence of amla.

Sensory analysis

The results of the study revealed that flavour, color and appearance of control (C) marmalade was significantly higher than T samples. However, taste and over all acceptability were not significantly different and T samples were accepted in liked limit. No crystallisation and change in texture was observed in all the samples over a period of 60 days (Table 4)

Microbial analysis

Microbial analysis of the developed products during the period of 60 days revealed following results (Table 5). Sample T2 showed maximum total viable bacteria as compared with C and T. The total viable bacteria were reduced in number because of higher acidity of the samples. Also in this experiment total soluble solids of all the samples was less than 70% which resulted in the minimum growth of bacteria during two months period. The results are similar to Taufik and Karim's study (Taufik, 1992).

Conclusion

Amla marmalade with 10% substitution of whey can be effectively said to be the best formulation as it has better sensory qualities, physico-chemical characteristics with low microbial count over a period of 60 days. It was substantially proved that whey can be efficiently substituted in marmalade with advantage of improving its nutritive, physico-chemical and textural properties without any detrimental effect on sensory properties and also avoiding much denaturation of whey proteins.

References

Akinyele LO, Keshinro O and Aminnawo OO (1990). Nutritional losses during and after processing of pineapples and oranges. *Food chemistry*, **37(3):** 181-188.

Asmawi (1993). Anti inflammatory activities of Embilica offcinalis, *J. Pharm. Pharmacol.*, **45(6):** 581-584.

AOAC, 2002. Official Methods of Analysis. 17th Edn., AOAC, Washington DC.

Boye JI, Ismail AA and Alli I (1996). Effects of physio chemical factors on the secondary structure of beta-lactoglobulin. *J. Dairy R.*, **63(1):** 97-109.

Duranti M, Pagani S, Iametti S and Carpen A (1989). Heat - induced changes of milk proteins rocket immuno electrophoretic detection of alpha lactalbumin. *Milchwissenschaft*, **44(3):** 142-144.

Damiani C, Boas VEVB, Junior SMS, Caliari M, Paula ML, Pereira DEP and Silva AGM (2008). Physical, sensory and microbiological analysis of mango jams formulated with different levels of peels in substitution to pulp. *Ciência Rural*, **38:** 1418-1423.

Ewaidah (1992). Studies on commercial canned juice produced locally in Saudi Arabia. *Physico-chemical organoleptic and microbiological assessment of food chemistry*, **44:** 2.

Geetanjali D and Kamat SK (2011). Antiinflamatory activities of Phylanthus emblica in acute models of inlamation. *Phytotheray Res*, **25(6):** 904-908.

Jenness R and Patton S (Ed.) (1959). "Principles of Dairy Chemistry" Chapman and Hall Limited , London. p.73-100.

Kulmyrzaev A, Bryant C and Mc Clemente DJ (2000). Influence of sucrose on the thermal denaturation, gelation and emulsion stabilization of whey proteins. *Journal of Agricultural and Food Chemistry*, **48:** 1593-1597. Doi: 10.1021/jf9911949.

Macrae R, Robinson RK and Sadler MJ (1993). Encyclopedia of Food Science, Food Technology and Nutrition. Academic Press Publication. Ltd., London, **3:** 2120-2123

Mishra AK (2009). Whey managemnt in Dairying. Dairy Year Book, 4th Ed., 2125.

Reddy GL, Rao BVR, Reddy KSR and Venkayya D (1987). Development of a whey beverage. *Indian Jouranal of Dairy Science*, **40(4):** 445-450.

Renner E (1990). Nutritional aspects. In: Whey and Lactose Processing J.G. Zadow (E.d.) , Elsevier Appl. Sci., London, p.449.

Ranganna S (1991). Handbook of Analysis of Quality Control for Fruit and Vegetable Products. 2ed. Tata McGrawHill Pub. Co. Ltd, New Delhi.

Siso MIG (1996). The biotechnological utilisation of cheese whey: A review. *Bio resource Technology*, **57:** 1-11. Doi: 10.1016/0960-8524(96)00036-3

Taufik YCM and Karim MNA (1992). Storage stability of ciku leather. *ASEAN Food Journal*, **1(7):** 53-55.

Vidigal MCTR, Minim VPR, Ramos AM, Ceresino EB, Diniz MDMS, Camilloto GP and Minim LA (2012). Effect of whey protein concentrate on texture of fat-free desserts: sensory and instrumental measurements. *Food science and Technology*, **32(2):** 412-418. Doi: 10.1590/S0101-20612012005000047.

Yadav V, Duvey B, Sharma S and Devi B (2017). Amla (*Emblica officinalis*) - Medicinal Food and Pharmacological Activity. International Journal Of Pharmaceutical and Chemical Sciences. ISSN: 2277-5005.

Zhang LZ, Zhao WH, Guo YJ, Tu and Lin S (2003). Studies on chemical constituents in fruits of Tibetan medicine Phyllanthus emblica. *Zhonggu*, **28(10):** 940-943.

Zhang W and Zhong Q (2010). Microemulsions as nanoreactors to produce whey protein nanoparticles with enhanced heat stability by thermal pretreatment. *Food chemistry*, **119:** 1318-1325. Doi: 10.1016/j.foodchem.2009.08.043.

Table1: Composition of the prepared marmalade sample

Composition GMS)	Control (C)	T1	T2
Amla Pulp	100	95	90
Whey	0	5	10
Sucrose	75	75	75
Pectin	1	1	1
Citric Acid	0.6	0.6	0.6
Apple Peel	20	20	20

Table 2: Chemical composition of the plain condensed whey and amla pulp

	Total solids%	Acidity%	Ash%	Fat%	Crude Protein%
Plain condense d whey	58.9 6	0.48	6.54	0.68	7.35
Amla Pulp	12.7	2.34	0.86	0.12	0.35

Table 3: Physico-chemical analysis of the different samples

		C	T1	T2
Acidity	0^{th} day	0.55±0.016	0.58±0.04	0.58±0.02
	30^{th} day	0.57±0.04	0.58±1.25	0.59±1.28
	60^{th} day	0.57±0.05	0.59± 0.56	0.59±1.58
TSS	0^{th} day	66.25±0.029	67.52±0.028	68.56±0.025
	30^{th} day	66.78±0.09	67.91±0.18	68.92±0.08
	60^{th} day	67.06±0.24	68.01±0.87	69.18±0.14
pH	0^{th} day	3.31±0.12	3.36±0.25	3.27±0.71
	30^{th} day	3.25±0.53	3.21 ±0.98	3.15±0.59
	60^{th} day	3.09±0.78	3.15±0.65	3.08±0.27
Ash%	0^{th} day	0.323±0.002	0.323±0.002	0.323±0.007
	30^{th} day	0.323±0.006	0.324±0.006	0.324±0.006
	60^{th} day	0.324±0.009	0.324±0.005	0.324±0.005
Moisture	0^{th} day	26.24 ± 0.21^{Aa}	28.74 ± 0.21^{Ba}	30.32 ± 0.25^{Ca}
	30^{th} day	25.22 ± 0.36^{Ab}	27.42 ± 0.78^{Bb}	29.60 ± 0.39^{Cb}
	60^{th} day	24.36 ± 0.54^{Ac}	26.19 ± 0.87^{Bc}	28.91 ± 0.17^{Cc}
Protein	0^{th} day	0.92 ± 0.028^{A}	3.15 ± 0.028^{B}	4.23 ± 0.03^{C}
	30^{th} day	0.85 ± 0.58^{A}	3.14 ± 0.13^{B}	4.20 ± 0.04^{C}
	60^{th} day	0.84 ± 0.24^{A}	3.12 ± 0.54^{B}	4.20 ± 0.03^{C}
Reducing Sugar	0^{th} day	16.20 ± 0.06^{Aa}	19.54 ± 0.02^{Ba}	22.17 ± 0.01^{Ca}
	30^{th} day	18.47 ± 0.03^{Ab}	25.63 ± 0.01^{Bb}	29.35 ± 0.05^{Cb}
	60^{th} day	24.30 ± 0.18^{Ac}	32.44 ± 0.01^{Bc}	37.49 ± 0.02^{Cc}
Non Reducing sugar	0^{th} day	45.18 ± 0.01^{Ac}	43.16 ± 0.01^{Bc}	40.28 ± 0.02^{Cc}
	30^{th} day	43.19 ± 0.12^{Ab}	37.24 ± 0.01^{Bb}	32.50 ± 0.02^{Cb}
	60^{th} day	38.54 ± 0.29^{Aa}	31.55 ± 0.08^{Ba}	26.23 ± 0.03^{Ca}

^{abc}means on the same line without a common letter are significantly different at $P < 0.05$. (all samples at the same time).

^{abc} means on the same column without a common letter are significantly different at $P < 0.05$. (single sample during storage period).

Table 4: Sensory Analysis of prepared samples

		C	T1	T2
Acidity	0th day	0.55±0.016	0.58±0.04	0.58±0.02
	30th day	0.57±0.04	0.58±1.25	0.59±1.28
	60th day	0.57±0.05	0.59±0.56	0.59±1.58
TSS	0th day	66.25±0.029	67.52±0.028	68.56±0.025
	30th day	66.78±0.09	67.91±0.18	68.92±0.08
	60th day	67.06±0.24	68.01±0.87	69.18±0.14
pH	0th day	3.31±0.12	3.36±0.25	3.27±0.71
	30th day	3.25±0.53	3.21 ±0.98	3.15±0.59
	60th day	3.09± 0.78	3.15±0.65	3.08±0.27
Ash%	0th day	0.323±0.002	0.323±0.002	0.323±0.007
	30th day	0.323±0.006	0.324±0.006	0.324±0.006
	60th day	0.324±0.009	0.324±0.005	0.324±0.005
Moisture	0th day	26.24 ± 0.21^{Aa}	28.74 ± 0.21^{Ba}	30.32 ± 0.25^{Ca}
	30th day	25.22 ± 0.36^{Ab}	27.42 ± 0.78^{Bb}	29.60 ± 0.39^{Cb}
	60th day	24.36 ± 0.54^{Ac}	26.19 ± 0.87^{Bc}	28.91 ± 0.17^{Cc}
Protein	0th day	0.92 ± 0.028^{A}	3.15 ± 0.028^{B}	4.23 ± 0.03^{C}
	30th day	0.85 ± 0.58^{A}	3.14 ± 0.13^{B}	4.20 ± 0.04^{C}
	60th day	0.84 ± 0.24^{A}	3.12 ± 0.54^{B}	4.20 ± 0.03^{C}
Reducing Sugar	0th day	16.20 ± 0.06^{Aa}	19.54 ± 0.02^{Ba}	22.17 ± 0.01^{Ca}
	30th day	18.47 ± 0.03^{Ab}	25.63 ± 0.01^{Bb}	29.35 ± 0.05^{Cb}
	60th day	24.30 ± 0.18^{Ac}	32.44 ± 0.01^{Bc}	37.49 ± 0.02^{Cc}
Non Reducing sugar	0th day	45.18 ± 0.01^{Ac}	43.16 ± 0.01^{Bc}	40.28 ± 0.02^{Cc}
	30th day	43.19 ± 0.12^{Ab}	37.24 ± 0.01^{Bb}	32.50 ± 0.02^{Cb}
	60th day	38.54 ± 0.29^{Aa}	31.55 ± 0.08^{Ba}	26.23 ± 0.03^{Ca}

SEM - Standard Error of mean

^{ABC} means on the same line without a common letter are significantly different at $P < 0.05$ (all samples at the same time).

Table 5: Microbial analysis of the prepared sample

Sample	Bacterial count (log cfu/ml)
C	2.00
T1	2.15
T2	2.25

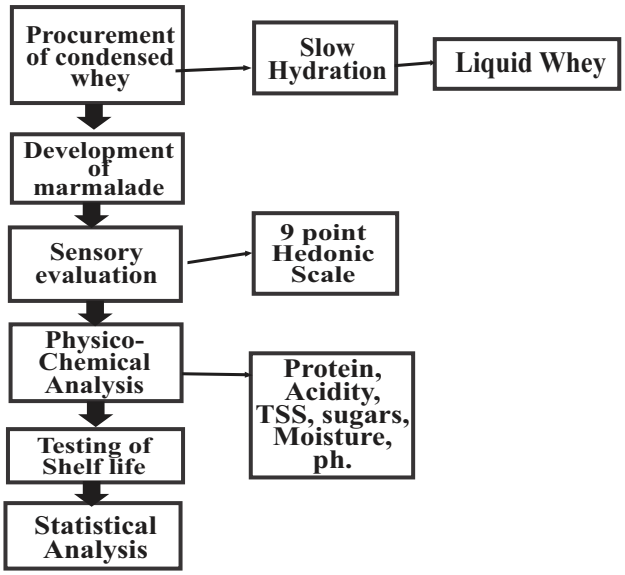

Fig 1: Methodology flowchart