African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 41-48)
www.abjournals.org

EFFECT OF FRUIT ACIDULANTS ON INSTRUMENTAL COLOUR VALUES AND SENSORY QUALITIES OF *PANEER*

Amina Ahmed[*1] and Usha Bajwa[2]

[*1]Department of Applied Sciences, Mbeya University of Science and Technology, Mbeya, Tanzania. Email: mimomed88@gmail.com

[2]Department of Food Science and Technology, Punjab Agricultural University, 141001-Ludhiana, Punjab, India. Email ushabajwa@rediffmail.com

Cite this article:

Amina A., Usha B. (2022), Effect of Fruit Acidulants on Instrumental Colour Values and Sensory Qualities of Paneer. African Journal of Agriculture and Food Science 5(2), 41-48. DOI: 10.52589/AJAFS-TK87FRW3.

Manuscript History

Received: 18 Feb 2022

Accepted: 16 March 2022

Published: 13 June 2022

ABSTRACT: *Colour is one of the important parameters for the acceptability of many food products. Therefore, a study was carried out to investigate the effect of milk coagulation with fruit juice acidulants (lemon and amla) on the instrumental colour values and sensory qualities of paneer (Indian soft cheese type). The paneer was prepared per standard methods, and paneer curry was prepared using commercial masala as labelled instructions. Raw materials and paneer were analysed for instrumental colour and expressed as *L, *a and *b values. First, sensory evaluation was conducted by blinding the type of acidulant used for raw and curried paneer and then disclosing the kind of acidulant used for raw paneer. We found that the fruit juice acidulants affected both instrumental colour values and sensory qualities of paneer. The sensory scores were highest for paneer coagulated with citric acid, followed by lemon and amla extracts. However, disclosing the type of acidulant used increased sensory scores for amla paneer while the scores for lemon paneer slightly decreased. Moreover, currying increased sensory scores of the amla paneer. Therefore, lemon and amla juice have potential in manufacturing paneer with high acceptability despite the colour imparted from the fruits.*

KEYWORDS: Instrumental colour values**,** fruit acidulants, paneer, sensory qualities

Article DOI: 10.52589/AJAFS-TK87FRW3
DOI URL: https://doi.org/10.52589/AJAFS-TK87FRW3

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 41-48)

www.abjournals.org

INTRODUCTION

Colour and flavour are essential sensory characteristics which play an important role in the selection, consumption, satiation, and ingestion of food (Dias et al., 2012). It affects consumer judgement of other sensory characteristics such as flavour, sweetness, and saltiness. In addition, it is an important predictor of nonsensory quality attributes such as moisture content, over-processing, and pigment content (Clydesdale, 1994). Therefore, colour is the most important parameter for the acceptability of a product, especially for the new products, as consumers relate it to a characteristic of the product perception, including safety and quality (Juyal *et al.,* 2015; MacDougall 2002). The colour of the food may result in both physical and psychological reactions, thus why unattractive foods are rarely tested despite the good aroma and nutritional quality (Crepaldi, 2006; Clydesdale, 1994). At some points, instrumental colour analysis can be used as a rapid test for estimating the food compounds such as chlorophyll, anthocyanin and carotenoid content (Meléndez-Martínez *et al*., 2005) that contribute to a specific colour of the most plant produce. Therefore, the food industry is now frequently seeking to develop many foods and beverages to create functional and speciality products by adding or substituting some ingredients, which may directly affect such particular food's nutritional and sensory qualities. Consumer demand for such functional products increases daily (Shori and Baba 2013). However, adjusting the sensory perceptions, including the colour and flavour of the products, are the greatest challenge in new product development.

Paneer is a type of unripened cheese popular in India. It is prepared by coagulating heated milk with citric acid (Aneja *et al*., 2002). Generally, the production of high-quality cheese requires thorough control of parameters, including colour, appearance and flavour (Leiva and Figueroa, 2010). Several types and recipes of *paneer* with altered colour and flavour components have been studied (Kanchan, 2013; Verma, 2013; Kaur and Bajwa; 2003; Bajwa *et al.,* 2005). However, studies on the effect of fruit acidulants and their impact on colour and sensory qualities were not studied. Therefore, this study investigated the impact of fruit juice acidulants, lemon (*Citrus limon L*) and *amla* (*Emblica officinalis*), on the instrumental colour values and sensory attributes of raw and curried *paneer*.

MATERIAL AND METHODS

Preparation of raw materials

Standardised milk, citric acid, lemon and *amla* were procured from the local markets of Ludhiana, Punjab, India. First, sound lemon and *amla* fruits were washed with potable water and dried. Then, lemon was cut and manually squeezed to obtain juice, while *amla* was grated with a hand grater and pressed using mesh. Finally, the juices were filtered using a muslin cloth and heated to 75°C before coagulating milk for *paneer* manufacture.

Preparation of *paneer*

Paneer was prepared as per standard procedure given by De (2015). First, milk was heated to 85°C for 5 min, allowed to cool and coagulated at 72°C using 2 per cent citric acid solution or fruit juices till clear whey was separated. After that, the coagulum was strained, pressed, cooled, packaged and stored in a refrigerator for further analysis.

Article DOI: 10.52589/AJAFS-TK87FRW3
DOI URL: https://doi.org/10.52589/AJAFS-TK87FRW3

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 41-48)

www.abjournals.org

Preparation of curried *paneer*

Paneer curry was prepared using a commercially available spice mix (*Bhuna masala*). First, the *masala* was mixed with 150 ml of water and boiled for two minutes. Then, the cubes of *paneer* (1x1x1cm) were mixed with boiled *masala* and then boiled for two minutes.

Instrumental colour measurement

The colour values of the raw materials and *paneer* were measured using a Minolta Chromameter CR400 colourimeter (Konica Minolta, Inc., Marunouchi, Japan) and expressed as *L, *a and *b values. The *L measured brightness, varying from 100 for perfect white to 0 for black. The chromaticity dimensions (*a and *b) gave an understandable designation of colour, i.e. the value *a measured redness when positive, grey when zero and green when negative. The value *b measured yellowness when positive, grey when zero, and blueness when negative.

Sensory evaluation

Sensory analysis of raw (blind and disclosed samples) and curried *paneer* was performed by a panel of 10 judges using the nine-point hedonic scale (from 1= Dislike extremely to 9=Like extremely) (Larmond 1977). The sensory evaluation was conducted first by blinding the type of acidulant used, then disclosing for raw *paneer*, and blinded for curried *paneer*. The sensory attributes analysed were colour, flavour, texture, mouthfeel and overall acceptability.

Statistical analysis

The data were analysed for analysis of variance using the SPSS® 16.1 software package and were presented as mean ± standard deviation, and the mean differences were compared using the Least Significant Difference (LSD) test at a 95 per cent confidence interval.

RESULTS AND DISCUSSION

Instrumental colour values of the raw materials and *paneer*

The results on the colour values of the raw materials are presented in Table 1. Milk had the highest *L value (88.57), followed by *amla* (64.60) and lemon (47.60). The *a values were highest in *amla* (0.90), followed by milk (-3.72) and lemon (-6.52). Similarly, the *b values were highest in *amla* (22.93), followed by milk (19.73) and lemon (8.70). Heating the fruit extracts resulted in changes in the colour values. The *L values for fresh and heated lemon extracts were similar, whereas *amla* extract differed significantly ($p<0.05$) after heating. After heating fresh lemon extract, its *a values (greenness) were not altered, whereas the redness of *amla* juice increased, but the change was non-significant. Also, all the extracts' *b values (yellowness) significantly increased after heating.

However, Nagpal (2012) reported that the *L, *a and *b values for fresh *amla* extract were 77.16, -0.86 and 16.96, respectively. Similar observations for colour values of milk were reported by Giangiacomo and Messina (1988); the *L, *a, and *b values of milk were 88.2, -4.35, and 5.40, respectively. On the other hand, Chugh *et al.* (2014) found respective values of 64.50, -3.92 and 0.15 for skimmed milk. The polyphenol contents of the fruits and grasses

Article DOI: 10.52589/AJAFS-TK87FRW3
DOI URL: https://doi.org/10.52589/AJAFS-TK87FRW3

impact the colour of the plant extract (Patel and Goyal 2012; Shi *et al.* 2010; Economos and Clay 1998). Therefore, variation in the colour of milk and milk products is normally high due to variation in composition, particularly pigments (Jenness 1985; Urgu et al., 2019). The yellow colour of milk is associated with fat and carotenoids, particularly β-carotene (Urgu et al., 2019; Połtorak et al., 2015).

The results on the effect of acidulants on the colour values of *paneer* are presented in Table 2. The *L values were highest in *paneer* from citric acid (86.49), followed by lemon (86.11) and *amla* (78.92). The *a values were highest in *paneer* from *amla* (2.00), followed by citric acid (-0.08) and lemon (-0.36). The *b values were highest in *paneer* from lemon (15.66), followed by citric acid (13.28) and *amla* (10.77). The *L value of citric acid and lemon were statistically similar, but both differed with *amla*. That implied that the *paneer* coagulated with citric acid was more whitish than lemon and *amla* fruit acidulants (Plate 1). Similarly, Shrivastava *et al.* (2013) reported 87.55, -1.35 and 8.36 for *L, *a and *b values, respectively, for the *paneer* coagulated with citric acid. The highest *a value of *amla paneer* indicated high retention of the red pigments tannins, as reported in our previous study (Ahmed and Bajwa, 2019). The highest *b values in *paneer* from lemon suggested higher retention of yellow pigments, possibly fat and β-carotene, than in citric acid and *amla*.

Table 1. Instrumental colour values of milk and fruit extracts

Parameter	Fresh Milk	Fresh lemon extract	Heated lemon extract	Fresh *amla* extract	Heated *amla* extract
L (± lightness/darkness)	88.57± 0.170	47.60^{a}± 0.461	47.90^{a}± 0.301	64.60^{x}± 1.12	59.37^{y}± 0.02
a (± redness/greenness)	-3.72± 1.19	-6.52^{a}± 0.057	-6.50^{a}± 0.021	0.90^{x}± 0.036	1.01^{x}± 0.11
b (± yellowness/ blueness)	19.73± 0.035	8.70^{a}± 0.280	9.76^{b}± 0.095	22.93^{x}± 0.177	23.96^{y}± 0.10

Values in a row with different superscripts (a and b for lemon, x and y for *amla*) differed significantly at $p<0.05$

Table 2. Effect of acidulants on instrumental colour values of *paneer*

Type of acidulant	L *	a*	b*
Citric	86.49^{a} ± 0.97	-0.08^{a} ± 0.10	13.28^{a} ± 0.44
Lemon	86.11^{a} ± 0.37	-0.36^{a} ± 0.15	15.66^{b} ± 0.70
Amla	78.92^{b} ± 0.35	2.00^{b} ± 0.17	10.77^{c} ± 0.25

Values in a row with different superscripts differed significantly at $p<0.05$

Article DOI: 10.52589/AJAFS-TK87FRW3
DOI URL: https://doi.org/10.52589/AJAFS-TK87FRW3

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 41-48)
www.abjournals.org

Effect of acidulants on sensory scores of *paneer*

The effect of acidulants on the sensory scores of *paneer* is presented in Table 3. For the raw-blinded *paneer*, the colour score was highest in *paneer* from citric acid (8.25), followed by lemon (8.18) and *amla* (6.62) acidulants. Interestingly, disclosing the type of acidulant caused the change in the sensory scores of raw *paneer* from lemon and *amla*. The sensory score for lemon significantly decreased, whereas for *amla* increased. However, the curried *paneer* from *amla* scored highest, followed by citric acid and lemon. The strange colour of *amla paneer* influenced the sensory scores of raw-blinded *paneer* for body and texture, mouthfeel, flavour, and overall acceptability.

Nevertheless, disclosing the type of acidulant significantly increased the sensory scores of all the parameters of *amla paneer*. On the other hand, the opposite was true for *amla* from the lemon extract. Similarly, (Dias et al., 2012) found that the limes flavour negatively influenced jellies' acceptance compared to the other flavours.

The lowest score of *amla paneer* might be due to the light reddish/brownish colour imparted by phenolic compounds, especially tannins found in abundance in *amla* extract (Ahmed and Bajwa, 2019). The colour of the *paneer* from *amla* made the panel curious to know the reason behind the colour. On the other hand, the increase in sensory scores of the raw *paneer* from *amla* might be due to its health benefits which are well known in India (Shi *et al.* 2010, Patel and Goyal 2012). For example, *Amla* has been used in Ayurvedic medicine to reduce common colds and alleviate asthma (Allemullah 1995).

Table 3. Effect of acidulant on sensory scores of *paneer*

	Type of *paneer*		
Acidulants	**Raw blind**	**Raw disclosed**	**Curried**
	Colour		
Citric acid	8.25^{a} ±0.46	8.43^{a} ±0.49	8.12^{a} ±0.64
Lemon	8.18^{a} ±0.75	6.87^{b} ±1.64	7.87^{a} ±0.87
Amla	6.62^{a} ±1.06	8.06^{b} ±0.67	8.50^{b} ±0.59
	Body and texture		
Citric acid	7.87^{a} ±0.83	8.50^{a} ±0.75	8.18^{a} ±0.65
Lemon	7.75^{a}±0.75	7.50^{a} ±0.92	7.75^{a} ±0.88
Amla	6.87^{a} ±0.79	8.12^{b} ±0.69	8.37^{b} ±0.58
	Mouthfeel		
Citric acid	8.00^{a} ±0.75	8.25^{a} ±0.70	7.87^{a} ±0.83
Lemon	7.62^{a} ±0.58	7.43^{a} ±0.72	7.87^{a} ±0.99
Amla	7.50^{a} ±0.96	8.25^{b} ±0.53	8.04^{b} ±0.85
	Flavour		
Citric acid	8.00^{a} ±0.75	8.06^{a} ±0.77	7.87^{a} ±0.79
Lemon	7.87^{a} ±0.79	7.37^{a} ±0.74	7.68^{a} ±0.99
Amla	6.93^{a} ±1.03	7.87^{b} ±0.69	8.00^{b} ±0.53
	Overall acceptability		
Citric acid	8.11^{a} ±0.51	8.37^{a} ±0.49	7.96^{a} ±0.70
Lemon	7.91^{a} ±0.87	7.37^{b} ±0.98	7.76^{a} ±0.86
Amla	7.10^{a} ±1.00	8.08^{b} ±0.64	8.21^{b} ±0.52

The values with different superscripts in a row differed significantly at $p<0.05$

Article DOI: 10.52589/AJAFS-TK87FRW3
DOI URL: https://doi.org/10.52589/AJAFS-TK87FRW3

African Journal of Agriculture and Food Science
ISSN: 2689-5331
Volume 5, Issue 2, 2022 (pp. 41-48)
www.abjournals.org

Generally, the *paneer* from *amla* had the highest sensory scores for all the sensory parameters. However, the sensory scores for the *paneer* from citric acid were not affected whether it was blinded, disclosed or curried. Kanchan (2013) and Verma (2013) observed increased sensory scores of *paneer* added with chickpeas and masala, respectively. Nalkar *et al.* (2009) reported a score of 7.8 for the colour/ appearance of fried *paneer* prepared from cow milk using 2 per cent citric acid. Therefore, the colour of the *masala* positively affected the eye appeal of the *paneer*.

Plate 1. Raw paneer (left) and curried paneer (right)

CONCLUSION

Milk coagulation using lemon and *amla* extracts affected the *paneer*'s colour and sensory attributes. The use of fruit acidulants resulted in low acceptability of *paneer* from *amla* extract, but disclosing the type of acidulant significantly increased the sensory scores. In addition, the well-known health benefits of *amla* fruit could influence the acceptability of the *amla paneer*. Moreover, currying the *paneer* increased the sensory scores of the *paneer*. Therefore, both lemon and *amla* juice have potential in manufacturing *paneer* with high acceptability irrespective of the colour imparted from the fruits.

Acknowledgements

The authors appreciate the contribution of Dr Sukhjit Kaur Jawandha, Assistant Horticulturist, Department of Fruit Science at Punjab Agricultural University, for her valuable assistance on instrumental colour analysis.

Funding

The first author is thankful for financial support from the iAGRI-Tanzania/Ohio State University project under the ‘‘Feed the Future Program’’ to conduct research and fulfil other M.Sc. (Food Technology) degree requirements.

Article DOI: 10.52589/AJAFS-TK87FRW3
DOI URL: https://doi.org/10.52589/AJAFS-TK87FRW3

REFERENCES

Ahmed, A. and Bajwa, U. (2018). Composition, texture and microstructure appraisal of *paneer* coagulated with sour fruit juices. *J Food Sci Technol.* 1 – 9. https://doi.org/10.1007/s13197-018-3484-4.

Allemullah, M. (1995). The Indian gooseberry. School of Horticulture, University of Western Sydney, Australia.

Bajwa, U., Kaur, J., Sandhu, K. S. (2005). Effect of processing parameters and vegetables on the quality characteristics of vegetable fortified *paneer*. *J Food Sci Tech* **42**:145–150.

Butool, M. and Butool, S. (2015). Studies on carrot incorporated soy *paneer*. *Int J Dev Res* **5**(4):4124-30.

Clydesdale, F. M. (1994). Changes in colour and flavour and their effect on sensory perception in the elderly. *Nutrition Reviews*, **52**(8): S19-S20. http://dx.doi.org/10.1111/j.1753-4887.1994.tb01441.x

Crepaldi, L. A. (2006). Influência das cores na decisão de compra: Um estudo do comportamento do consumidor no ABC paulista. In: Congresso Brasileiro De Ciências Da Comunicação - Intercom, 29: pp. 1-11.2006, Brasília. Anais... Brasília.

De, S. (2015). Outlines of Dairy Technology. p. 156. 30th edtn, Oxford University Press, New Delhi.

Dias, N. A., Lara, S. B., Miranda, L. S., Pires, I. S. C., Pires, C. V. and Halboth, N. V. (2012). Influence of colour on acceptance and identification of flavour of foods by adults. *Ciênc. Tecnol. Aliment., Campinas*, **32**(2): 296-301.

Economos, C. and Clay, W. D. (1998). Nutritional and health benefits of citrus fruits. *Food Nutr Agric*., **24**:11–18.

Ege University (2019). Color Measurement in Foods. http://eng.ege.edu.tr/~otles/ColorScience/cmf.htm

Giangiacomo, R. and Messina, G. (1989). Applicabilità della colorimetria tristimolo per la valutazione della struttura dei coagulo di yogurt. *Ind Latte*, **25**:67-79.

Juyal, D., Singh, A. and Kumar, M. (2015). Production of powder from kinnow juice using spray drying technology. *Agr. Res J*, **52**(1): 37-41.

Kanchan, A. (2013). Mutter *Paneer* in Packet. *Consumers Voice*, 28-30.

Kaur, J., Bajwa ,U. and Sandhu, K. S. (2003). Effect of brining on the quality characteristics of plain and vegetable impregnated *paneer*. *J Food Sci Technol.*, **40**(5):534-37.

Kilcast, D. (2013). Measurement of the sensory quality of food: an introduction. Editor(s): Kilcast, D. In Woodhead Publishing Series in Food Science, Technology and Nutrition, Instrumental Assessment of Food Sensory Quality, Woodhead Publishing, Pages 1-26, ISBN 9780857094391, https://doi.org/10.1533/9780857098856.1.

Kneifel, W., Ulberth, F. and Schaffer, E. (1992). Tristimulus colour reflectance measurement of milk and dairy products. *Le Lait*, **72** (4): 383-391.

Larmond, E. (1977). Laboratory Methods for Sensory Evaluation of Foods. Pub.163. Deptt Agric Res Branch Canada, National government publication, Ottawa, Ontario.

Leiva, J. and Figueroa, H. (2010). Texture of Chanco cheese: projection of a sensory map based on multivariate analysis. *Ciencia eInvnestinacion Agraria*, **37**: 85–91.

MacDougall, D. B. (2002). Colour in Food: *Improving Quality*. Woodhead Publishing. 367-378. ISBN 9781855735903. DOI: https://doi.org/10.1016/B978-1-85573-590-3.50019-2.

Article DOI: 10.52589/AJAFS-TK87FRW3
DOI URL: https://doi.org/10.52589/AJAFS-TK87FRW3

Meléndez-Martínez, A. J., Vicario, I. M. and Heredia, F. J. (2005). Instrumental measurement of orange juice colour: a review. *J. Sci. Food Agric*., **85**: 894-901. doi:10.1002/jsfa.2115

Nagpal, S. (2012). Effect of processing conditions on the quality and colour stability of *amla* beverages. A thesis submitted to Punjab Agricultural University, Deptt Food Science and Technology, Ludhiana, India. pp75.

Patel, S. S. and Goyal, R. K. (2012). *Emblica officinalis* great: A comprehensive review on phytochemistry, pharmacology, and ethnomedicinal uses. *Res J Med Plant,* **6:** 1 - 16.

Segnini, S., Dejmek, P. and Öste, R. (1999). Relationship between instrumental and sensory analysis of texture and colour of potato chips. *Journal of Texture Studies,* **30**: 677-690. doi:10.1111/j.1745-4603.1999.tb00237.x

Shi, J., Ho, C. H. and Shahidi, F. (2010). Traditional Indian functional foods. In: *Functional Foods of the East*. Pp 62 – 63. CRC Press, New Delhi.

Shori, A. B. and Baba. A. S. (2013). Antioxidant activity and inhibition of key enzymes linked to type-2 diabetes and hypertension by Azadirachta indica-yoghourt. *J Saudi Chemical Soc*., **17**(3): 295–301.

Shrivastava, S., Goyal, S. and Goyal, G. K. (2013). Effect of modified atmosphere packaging on colour profile of *paneer* stored at 3±1ºC. *J Agri Sustainability,* **3**(2):195-204.

Urgu, M., Türk, A., Ünlütürk, S., Kaymak-Ertekin, F., & Koca, N. (2019). Milk Fat Substitution by Microparticulated Protein in Reduced-fat Cheese Emulsion: The Effects on Stability, Microstructure, Rheological and Sensory Properties. Food science of animal resources, 39(1), 23–34. doi:10.5851/kosfa.2018.e60

Verma, A. and Chandra, R. (2012). Sensory properties of fried filled milk *paneer*. *J Dairying Foods Home Sci.,* **31**(1):13-15.

Wyszecki, G. and Stiles, W. S. (1982). Colour Science. Concepts and Methods. Quantitative Data and Formulae. Wiley, New York.

Article DOI: 10.52589/AJAFS-TK87FRW3
DOI URL: https://doi.org/10.52589/AJAFS-TK87FRW3