



Development and Quality Evaluation of Mozzarella Cheese Enriched with Mustard Sauce and Walnut Powder

Rashmi Pandey^{1*}, Sunita Mishra², Srishti Tripathi¹ and Amardeep Singh Chauhan¹

¹Food Science and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow, India

²Professor, Dean, Head, Babasaheb Bhimrao Ambedkar University, Lucknow, India

***Corresponding Author:** Sunita Mishra, Food Science and Technology, Babasaheb Bhimrao Ambedkar University, Lucknow, India.

Received: September 30, 2021

Published: October 20, 2021

© All rights are reserved by **Rashmi Pandey, et al.**

Abstract

The study was based on the enrichment of mozzarella cheese incorporated with mustard sauce and walnut powder. Mozzarella cheese added with mustard sauce and walnut powder, was formulated, prepared, categorized in order to know its quality and influenced by their variables: addition of mustard and addition walnut powder, manufacturing process and storage time.

The effect of each variable was different; the incorporating of mustard and walnut powder (30gm-50gm) to improved the nutrition value and properties and enrich the quality of mozzarella cheese.

After the enrichment of the mozzarella cheese, microbiological analysis (TPC) was analyzed for the fresh cheese and stored cheese (15 days) for assessment of the shelf life of mozzarella cheese. Physicochemical properties such as fat, protein, moisture, acidity and total solid content were evaluated and flavor, test, color appearance, texture were also evaluated by sensory method.

After the analysis of result, it was conclude that shelf life of mozzarella were increased due to presence of antimicrobial mustard sauce and moisture were decreases from T0 to T1 and incorporation of walnut powder (T2) in cheese slightly affect to appearance and taste, and shelf life were increased in the treatment T1 compare than treatment T2. Both variables are acceptable by the expert panel members, thus the Mustardzella cheese samples has good survey scores and walnut cheese also acceptable by panel members due to its nutritious properties.

Keywords: Enrichment; Mustard Sauce; Walnut Powder; Incorporation; Mozzarella Cheese

Introduction

In the world's context, cheese is highly demanding dairy product. The cheese market in India exhibited strong growth during 2015 - 2020. Manufactures are originated a number of flavored cheese product including oregano, salt, garlic ginger etc. Changing food patterns, increasing demand of cheese. Mozzarella cheese

is a traditionally Southern Italian cheese made from Italian buffalo milk. The cheese became popular in the 12th century. The term mozzarella first emerged in Italy in 1570, Mozzarella cheese is generally appear white.

Mozzarella is a soft and white in appearance and it consist high moisture content. This type of cheese lowers in sodium (Na) and

calorie. It also contain bacteria that act as probiotics (Lactobacillus casei and Lactobacillus fermentum) and these prebiotics may strengthen immune system and help from infection and also fine source of niacin and biotin. B7 helps to lower blood glucose level in diabetic people and also rich in riboflavin, which help to reduce chances of migraine attacks, anemia. Whereas B3 helps to helps to control cholesterol. It's a good source of phosphorous, protein and potassium.

According to previous study storage life of traditionally made mozzarella cheese maximum two week. Cheese susceptible to biochemical, chemical and physical spoilage. Enzymatic decomposition, growing micro-organisms (psychotropic and mesophilic), oxidation of lipid are the main factors, that affect the stability of mozzarella cheese. Shelf life of cheese can extend by using Map (modified atmospheric packaging) system with suitable temperature and proper packaging material. Active and edible coating (eg-whey protein, pectin, calcium lactate buffered brine etc.) rapidly for the enrichment as well as for extending shelf life of cheese. Addition of preservative (benzoate, sorbate, natamycin) can prolong shelf life of cheese. Inactivation of vegetative micro-organism, fungal spore, plant cells, parasite can be done by HP method, using of special equipment made it some expensive.

In this study, mustard sauce uses as antimicrobial agent, mustard seeds as functional ingredient have proven their beneficial effects in humans, such as anti cancerous property and also reduce the chances of CVD problems because mustard seeds contain mono-unsaturated fatty acid (omega-9 fatty acid). Mustard seeds prevent the growth of bacteria and it has a natural spicy flavor which provides textural attributes to mozzarella cheese. As well as walnut having significant amounts of vitamins, essential amino acid and maximum number of natural antioxidant. The study was designed for the enrichment of mozzarella cheese by use of mustard sauce and walnut powder to increase the shelf life and enhance the properties of mozzarella cheese.

Objectives

- Preparation of mozzarella cheese by using full cream milk.
- Shelf life study of mozzarella cheese.
- Organoleptic properties of mozzarella cheese.

Materials and Methods

In this section we discussed about the material and methodology had used for the development of new flavored mozzarella cheese.

Collection of sample

Mozzarella cheese was developed by full cream milk. In this research approx half of litter (500 ml) of full cream pasteurized milk was used as main raw material. Vinegar (acetic acid) were used to coagulate milk using acetic acid turn into curd for making cheese other raw material were NaCl (Sodium chloride), drinkable water and packaging materials.

Milk	1 liter
Salt	1 spoon
Mustard sauce	100 gm
Dehydrate walnut powder	100 gm

Table 1: Total Ingredient.

Yellow mustard	100 gm
Vinegar	160 gm
Red chilly	1/2 spoon
Garlic	2 pcs
Salt	1 spoon
Walnut	100 gm

Table 2: Materials for the preparation of mustard sauce.

Methodology

The study was designed for the development of mozzarella cheese by use of acetic acid. For the development of the mozzarella cheese of three types of treatments have been taken in which, T0 as control sample, without any enrichment of products. Now mustard sauce would be added in T1 sample and T2 sample were treated (incorporated) by walnut powder. The study was designed for the development of mozzarella cheese by use of acetic acid. For sample were prepared separately for better result.

Preparation of mozzarella cheese

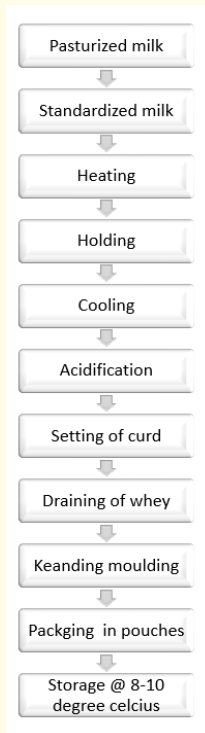


Figure 1: Preparation of mozzarella cheese.

Sample	Milk	Vinegar	NaCl(gm)	Mustard sauce
T1	500 ml	10ml	1.2	10 gm
T2	500 ml	15ml	1gm	20 gm
T3	500 ml	5ml	0.5 gm	25 gm
T4	500ml	20 ml	1.5 gm	30 gm

Table 3: Composition of mustard cheese.

Sample	Milk	vinegar	Nacl	Walnut Powder
T1	500 ml	10 ml	0.5gm	15 gm
T2	500 ml	15 ml	1 gm	20 gm
T3	500 ml	20 ml	0 gm	30 gm
T4	500 ml	5 ml	1 gm	10 gm

Table 4: Preparation of Walnut Cheese.

Physiochemical analysis

Determination of protein content by kjeldhal method

$$\%N = \frac{\text{Sample-blank} \times N \text{ of HCL} \times \text{Vol of Digest} \times 0.014}{\text{Allquot Taken} \times \text{Wt. of sample}} \times 100$$

Where,

S= Sample titrate reading

B= Blank Titrate reading

Determination of fat content by Soxhlet Method

$$\%Fat = \frac{W_1 - W_2}{w} \times 10$$

Where,

W1= Initial weight of round flask

W2= Final weight of flask + fat

W= Weight of sample.

Determination of ash content

$$\text{Ash}\% = \frac{w_2 - w_1}{w}$$

Where,

W2= Final weight of dish + Ash

W1= Weight of dish

W= Weight of sample

Determination of ash content

$$M.C. = \frac{\text{wt of at desired time} - \text{wt of none dry material}}{\text{wt of sample at any time}} \times 100$$

Cheese Yield = the cheese mass per equivalent volume of the initial milk.

$$\%Yield = \frac{\text{mass(g) of produced cheese} \times 100}{\text{Initial mass(g) of the milk}}$$

Shelf life of mozzarella cheese

Shelf life is the durability of a product may be stored without becoming unfit for consumption. For the measurement of the shelf life of the cheese, it has been stored at 4C temp for alternate days and measured by TPC (total plate count), current 1st, 3rd, 5th, 7th, 9th. Shelf life of mozzarella cheese was done by incubating the sample and counting colonies for TPC, yeast and molds. Mostly shelf life depends on the contamination by things, light, moisture and transmission of gases.

Statistical analysis

Data analyzed from the physiochemical properties and sensory evaluations was subjected to analysis of variance technology two way classifications and for the determination of best treatment Completely randomized design (CRD) was used.

CRD was used to know the significant different between control sample other treated sample.

Result and Discussion

The research was conducted for "Study on quality evaluation and development of mozzarella cheese added with mustard sauce and walnut power". In the department of Food Science Technology, school of home science, BBA University Lucknow (pin-) U.P. INDIA.

The data collected from different sources, as pre plan were tabulated and analyzed statistically. In this research included some modifications that were incorporated through the cheese manufacturing process. Measuring the sample property with different enrichment.

Development of mozzarella cheese added with walnut and mustard sauce

For the development of enriched mozzarella cheese, ingredients had taken from market e.g. (white mustard seed, walnut, 500ml buffalo milk etc.). collected milk sample was put on gas stove at above 60c for 2 to 3 minutes. After heating of the sample put it Ton holding state for few second, for making curd from the milk, first add dilute white vinegar (acetic acid). Development of mozzarella cheese without use of any commercial enzyme Curds are later drained and salted.

For the purpose of making more flavored and enhance shelf life of the cheese, 30 to 40 gm of mustard sauce and walnut powder added into control sample of cheese. After the settlement of the cheese, it cooked for few minutes at 40c in oven (microwave).After settlement of both varieties of cheese, it were packed in air packed plastic, pouches. After packaging, the packets were stored at 4c to 10c.

Physio-chemical analysis

Chemical analysis of both variables

During the represent observation on the development of the mozzarella cheese added with mustard sauce and walnut powder,

it was analyzed that there were a significant change in the value of protein, ash (total solid), fat acidic, moisture content. This was due to presence of mustard sauce in sample T1 and presence of walnut in sample T2 during the development of mozzarella cheese.

Protein content in mozzarella cheese-

The data regarding protein percentage in cheese sample of different treatments are showed in table 5. From the represented data on mean percentage of different treatment was, T2 (22.9), T1 (22.25) and T0 (22.54). The difference between the mean values of T0 -T1 (0.16) was similar than the C.D. value, 0.31; the difference

Sr. No.	Treatment	Replication (%)				Total	Mean
		R1	R2	R3	R4		
01	T0	23.01	22.04	21.1	24.02	90.17	22.5425
02	T1	20.02	24.1	23.02	22.01	89.15	22.2875
03	T2	22.01	22.08	23.01	24.5	91.6	22.9

Table 5: Analysis of Protein.

was significant. The difference between the mean values of T0 -T2 (0.36) was similar than C.D. value, 0.31; so the difference was significant. The differences between the man values of T2 - T1 (0.62); so the difference was significant.

Fat content in mozzarella cheese

The findings regarding fat percentage in mozzarella cheese sample of different treatment are showed in table 6. From the perusal of data on fat percentage in mozzarella cheese, incorporation with mustard sauce and added with walnut powder. Cheese sample of different treatment and control the highest mean fat percentage. Mozzarella cheese sample T0 (24.75), T1 (26.65), T2 (32.28).therefore, the difference between the mean values are T0 -T1 (1.89) was greater than the C.D. value, 0.9233; Therefore the difference was significant. The difference between the mean values of T0 - T2 (7.5); Therefore, the difference was significant. Above result have been supported by assessment of authors.

Total solid content (TSS) content in mozzarella cheese

The data regarding percentage of protein in mozzarella cheese sample of different treatment are present in table 7. From the represented data on protein percentage in mozzarella cheese incorporation with different treatment and control the highest mean

Sr. No.	Treatment	Replication (%)				Total	Mean
		R1	R2	R3	R4		
01	T0	25.0	26.1	23.03	25.01	99.14	24.785
02	T1	26.0	25.3	28.0	27.4	106.7	26.675
03	T2	30.1	32.0	34.0	33.02	129.12	32.28

Table 6: Analysis of fat content.

percentage mozzarella cheese sample of T0 (42.72), T1 (46.02), T2 (46.84). The difference between the mean value T0 - T1 (4.7) was similar to the C.D. value, 4.673. Therefore, the difference was significant. The difference between the mean value T0 - T2 (4.16) was similar to the C.D. value, 4.673. Therefore the difference was significant.

Sr. No.	Treatment	Replication (%)				Total	Mean
		R1	R2	R3	R4		
01	T0	43.7	42.01	42.3	42.9	170.91	42.727
02	T1	45.7	48.01	44.3	46.1	184.11	46.027
03	T2	48.2	49.01	48.15	42.0	187.36	46.84

Table 7: Analysis of TSS.

Moisture content in mozzarella cheese

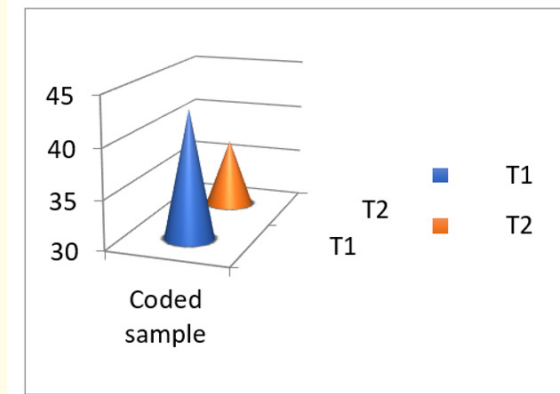
The observations regarding moisture present in mozzarella cheese sample to different treatment are showed in table 8. The perusal of data of moisture present and control the highest mean moisture present was recorded in the T0 (56.67), T1 (51.37), T2 (54.12). The difference between the mean values of T0-T1 (5.30) was higher the c.d. value, 2.424. Therefore, the difference was significant. The difference between the mean values of T0-T2 (2.55) was lower than C.D. value, 2.4.24. Therefore, the difference was significant. The difference was significant, above result have been finalized by the support of findings of author.

Sr. No.	Treatment	Replication (%)				Total	Mean
		R1	R2	R3	R4		
01	T0	55.1	57.3	58.3	56.0	226.7	56.675
02	T1	50.1	50.3	52.1	53.0	205.5	51.375
03	T2	52.1	53.2	55.1	56.1	216.5	54.125

Table 8: Analysis of Moisture.

Physical analysis of enriched mozzarella cheese Appearance

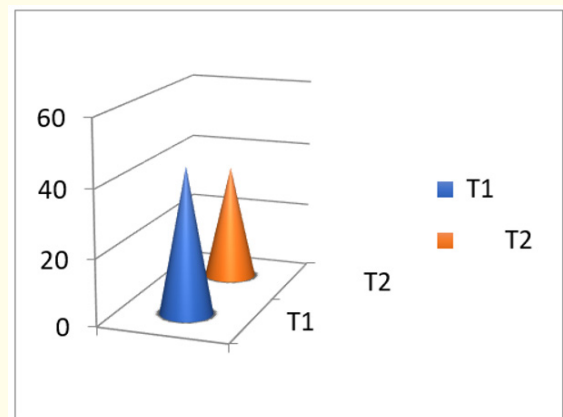
Physical analyses of enriched mozzarella cheese were based on the sensory score. The data regarding different treatment were represent by graph 1, where the score of T1 (44) treatment is higher than the T2 (37) treatment for the appearance of mozzarella cheese.



Graph 1: Appearance Score of Mozzarella Cheese.

Flavor and taste

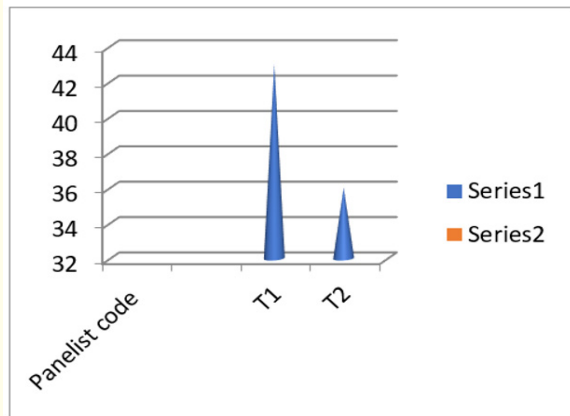
The data regarding flavor and taste analysis represented by graph 2. Score of T1 and T2 is respectively 44 and 35. Treatment T1 scores higher than treatment T2.



Graph 2: Flavor and Taste Score of Mozzarella Cheese.

Texture and consistency

Textural analyses of enriched mozzarella cheese were based on the sensory score. The data regarding different treatment were represent by graph 3, where the score of T1 (44) treatment is higher than the T2 (38) treatment for the appearance of mozzarella cheese.



Graph 3: Texture and Consistency of Mozzarella Cheese.

Microbiological analysis

Microbial population like fungus and bacteria were estimated by serial solidification in petriplate using nutrient agar. After solidification plates were incubated at room temperature for 24 to 48 hours. Then formed colonies were counted. Microbiological quality in the production line of Mozzarella cheese manufacture was investigated by analyzing 5 types of products: raw water, milk, thermized water milk, natural whey starter, governing liquid, and water buffalo Mozzarella cheese.

Shelf life of mozzarella cheese

Now days consumers demand product that are safe, ready to eat, nutritious with longer shelf life. For measurement of the shelf life of enriched mozzarella cheese, it has been stored for incubation period. Microbiological analysis of cheese showed no detectable growth of microorganism (10cfu/g) at 0 day.

During examine shelf life major components (fat, protein, TSS and ash) showed changing. From microbial point of view, treat-

Storage period	Total combined microbial count			Specified Microorganism (<i>Escherichia coli.</i>)
	T0	T1	T2	
1	6.12	5.13	5.68	Absent
3	6.24	5.53	5.82	
5	6.02	5.75	6.12	-
7	6.16	6.04	6.22	-

Table 9: The microbiological quality (Log10 cfu/gm) of mozzarella cheese during storage period from two manufactures under study.

ment T2 was more contaminated compared to that from treatment T1. Enrichment with treatments was also preventing from microbes and helps to enhance the shelf life of mozzarella cheese. So the cheese stored for 14 days.

Shelf life evaluation

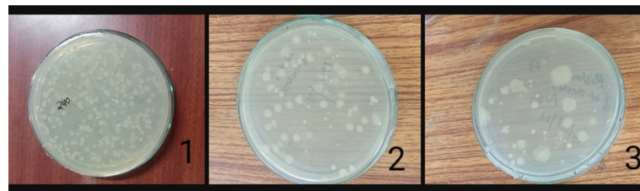


Figure 2: Shelf life evaluation of cheese after 14th days, Measured TPC (total plate count) (cfu/g) stored at 4°C. Control sample, sample 1(7.04 cfu/g), enriched with walnut powder, sample 2(6.50cfu/g) and Sample 3rd enriched with mustard sauce (6.23 cfu/g).

Conclusion

After the observation of the experimental data of the enrichment of mozzarella cheese, cheese of low moisture was formulated with mustard sauce and walnut powder. Three cheese systems were prepared, studied and stored. The mozzarella was modified to incorporate the mustard sauce and walnut powder with better result and yields. The presence of both ingredients influenced some properties of cheese e.g. overall acceptability, taste; flavor,

aroma and appearance were improved. It found that physico-chemical properties such as moisture, fat, protein and TSS, were also improved because of low moisture content [1-21].

It was represented that both cheese samples are different on the basis of sensory and nutritional properties. In particular, Control Sample (T0) identified by more whitening, off flavor and non-aromatic. Whereas Mustardzella cheese (mustard Sauce) T1 sample was identified by more spicy, different, elastic rather than other treatment. T2 sample, enriched with walnut paste, identified by fairly mild, off-flavor, fibrous. It is concluded that the flavor of mozzarella cheese with proportion of mustard sauce (T1) were liked more by panelist.

Acceptability of mustardzella cheese is higher rather than walnut cheese and it would be stored for more than the control sample. Therefore; enrichment of mozzarella cheese with mustard sauce and walnut powder change the entire taste.

Acknowledgment

I would like to thanks Prof. Sunita Mishra, Dean and Head, for School for home Science, Babasaheb Bhimrao Ambedkar Central University, Lucknow for her immense support and encouragement during the research planning and also for always showing the right path and enlightening students with her knowledge.

Bibliography

1. Vaibhav DM and Sanjeet K. "Study on the Development of Mozzarella cheese Adding Lipase Enzyme and its Quality Evaluation". *International Research Journal of Engineering and Technology* 3.9 (2016).
2. Fatma AM., et al. "Effect of manufacture steps on cheese structure" (2016).
3. Myrma Martinez and Jorge. "Development and Physicochemical Characterization of a Functional Mozzarella Cheese Added With Agavin". *Journal of Food Science and Nutrition Research* (2019).
4. Mohamed I., et al. "Microbiological characterization of Egyptian soft white cheese and identification of its dominant yeasts". *African Journal of Microbiology Research* 7.20 (2013).
5. Wendy Haws Rice and Donald. "Chemical, Physical, and Sensory Characteristics of Mozzarella cheese Fortified using Protein Chelated Iron or Ferric Chloride". (1998).
6. M E Johson. "A 100 – Year Review: Cheese Production and Quality". *Journal of Dairy Sciences* 100.12 (2017): 9952-9965.
7. D Ercan and F Korel. "Physicochemical, textural, volatile, and sensory profiles of traditional Sepet cheese". ELSEVIER (2011).
8. Rewati Raman Bhattarai Pushpa. "Preparation and Quality Evaluation of Mozzarella Cheese from Different Milk Sources". *Journal of Food Science and Technology Nepal* 6 (2010).
9. Chinellato N., et al. "Characterization of fresh cheese with addition of probiotics and prebiotics". *JFSN* (2013).
10. Mizuno R Lucey. "Effects of two types of emulsifying salts on the functionality of nonfat pasta filata cheese". *Journal of Dairy Sciences* 88.10 (2005): 3411-3425.
11. Ramirez-Navas JS. "Functional properties of cheese: with emphasis in pasta filata cheese". *Revista Reciteia* (2010).
12. De Oleveira and TM Fatima. "Development and evaluation of antimicrobial natamycin-in-corporated film in Gorgonzola cheese conservation". *Technology Science* (2007).
13. Manolopoulou E and P Sarantinopoulou. "Evolution of microbial populations during traditional Feta cheese manufacture and ripening". *International Journal of Food Microbiology* 82.2 (2003): 153-161.
14. Meilgaard MGV Civile and BT. "Sensory Evaluation Techniques". CRC Press (1999).
15. Francesca Losito Arinzo. "Microbiological safety and quality of Mozzarella cheese assessed by the microbiological survey method". *Journal of Dairy Science* 97.1 (2013).
16. McMahon DJ., et al. "Influence of calcium, pH, and moisture on protein matrix structure and functionality in directacidified nonfat Mozzarella cheese". *Journal of Dairy Sciences* 88 (2005): 3754-3763.
17. Merrill RK., et al. "A method for manufacturing reduced fat mozzarella cheese". *Journal of Dairy Sciences* 77 (1994): 1783-1789.

18. QL Ramos., *et al.* "Evaluation of antimicrobial edible coating from a whey protein isolate base to improve the shelf life of cheese". *Journal of Dairy Sciences* 95 (2012): 6282-6292.
19. Enab Ak., *et al.* "Effect of manufacture steps on cheese Structure (review)". *International Journal of Academic Research Part A* 4.6 (2012): 79-89.
20. Shalini Arora., *et al.* "Production and Processing Methodology of mozzarella cheese". *Journal of Dairy Sciences and Technology* 8 (2019).
21. Diana Palantik., *et al.* "Development Of Functional Cheese With Furctooligosaccharides". *Current Issues and Challenges in Dairy Science* (2019).

Volume 5 Issue 11 November 2021

© All rights are reserved by Rashmi Pandey., *et al.*