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## Comparative study on development of technology and quality analysis of pizza cheese (Mozzarella) and pizza cheese (Processed)

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### Abstract

Pizza cheese is one of the most liked cheeses for garnishing and sprinkling on number of food items like salads, toasts, fermented south Indian cuisines etc., apart from pizza itself. Pizza cheese is either pure mozzarella cheese or a blend of mozzarella and cheddar, which offers a unique taste and texture characteristics to the pizza. The present study was focused on optimization of ingredients and process technologies for the development of Pizza Cheese (Mozzarella Cheese) and Pizza cheese (Processed). The study analysed the altered fat content of milk, evaluating its effect on sensorial properties of pizza cheese. Various different ratios of milk fat were tested for the preparation of pizza cheese wherein the best composition was approved on the basis for its sensory properties. Various substitutions of (mozzarella curd: cheddar cheese) tested fell in the range of 100: 0, 50:50, 25:75 and 75:25 was also tried for preparation of Pizza cheese (Processed). From the results, 75 (mozzarella curd:) and 25% (cheddar cheese) combination showed best results and was undertaken into consideration for preparation of Pizza Cheese (Processed). The product was analyzed for its physico-chemical, microbiological and sensory analysis wherein there were significant differences was observed between these two types of cheese revealed by various parameters. However, all the parameters were within the limit of FSSAI standards.

**Keywords:** Mozzarella cheese curd, cheddar cheese, pizza cheese (mozzarella cheese) pizza cheese (processed), quality characteristics

### Introduction

Nutritionally, cheese is a rich source of essential nutrients like proteins, essential amino acids, minerals, vitamins, and fatty acids and is an excellent source of calcium, essential for the development and maintenance of healthy bones and teeth. Mozzarella is a soft and unripened cheese belongs to Pasta-filata family originated in the Battipaglia region of Italy. It is most commonly used cheese for pizzas due to its light & creamy texture and good stretchability having lot of culinary applications. The stringiness is its one of the exceptional behaviour that differentiates this cheese amongst others. The composition of cheese is totally dependent upon its parent raw material.

In recent times, where the modern switch of dietary habits towards westernization has led the popularity of pizza parlors on cloud nine, the augmented production of cheese has contributed significantly towards the recording rise in this industry (Anon, 2022) [1]. The segment of population constituting especially of youngsters have sparked the production of pizza cheese like anything before in modern times. Amongst varietal differences, Mozzarella cheese alone has a share of about 20% of total cheese consumed in India (Anon, 2016) [2]. The pizza market in India is worth over Rs 1,500 crores and has been growing at a Compound Annual Growth Rate (CAGR) of 26% for the last 5 years (Anon, 2019) [3]. However, due to diversification prevailing in the current food habits, the use of latest technologies of processing necessitates the specific tailor-made functionalities in the commercial cheese products. For example- the melting and stretching characteristics of Mozzarella cheese is a key ingredient for the manufacture of Pizza. (Jana, 2011) [4] The other characteristics like sliceability, shredability, gradeability in raw cheese and flowability, mouth feel, flavour and/or stretchability in cooked cheese is helpful to fulfil the demand of consumers either in the form of cheese or cheese toppings in the pizza, burger, and sandwich (Syed and Ghosh 2017) [5].

Pizza cheese (Processed) having more shelf life than Pizza Cheese (Mozzarella) is a mixture of mozzarella and cheddar deals a distinctive taste and texture features to the pizza, may be spreadable or cut into slices and pieces prepared by grinding, mixing, melting and emulsifying

one or more varieties of cheeses with the help of heat and emulsifying agents and contains both dairy ingredients and non-dairy ingredients like aromas, seasonings and fruit, vegetables and/or meat. This should not exceed one sixth of the weight of the total solids of the final product on dry matter basis.

Pizza cheese with its rising demand and upcoming potential requires customized production to serve customers to make it more of a complete food. Henceforth, keeping in view the above facts, the present investigation was aimed to compare and evaluate the Technology and Quality Characteristics of pizza cheese (mozzarella) and Pizza Cheese (processed).

## Materials and Methods

### Raw materials

Mixed milk was procured from Experimental Dairy plant of this college and was standardized for pizza cheese preparation. Culture to prepared Pizza cheese was purchased from CHR Hansen, India. Rennet (Fromase-2200 TL Granulate) was used for preparation of pizza cheese and was procured from Indian firm representing M/s. Gist-Brocades, Delf, Holland. Cheddar cheese to prepare processed cheese at later stage of the study was obtained from Verka Milk plant, Patiala. All the chemicals used in the study were of analytical grade.

### Preparation methodology

The Pizza Cheese (Mozzarella) & Pizza Cheese (Processed) (Figure 1 & 2) was prepared as per the procedure outlined by (Syed and Ghosh 2017) [5] with slight modifications. Cheddar cheese of different age groups (4 months) was used for the preparation of Pizza Cheese (processed). Different levels of pizza cheese and cheddar cheese were tried for processed cheese preparation. The ratios tried were 100:0, 75:25, 50:50, and 25:75. All ingredients were blended in double jacketed kettle and heated at 80-85 °C for 20 minutes.

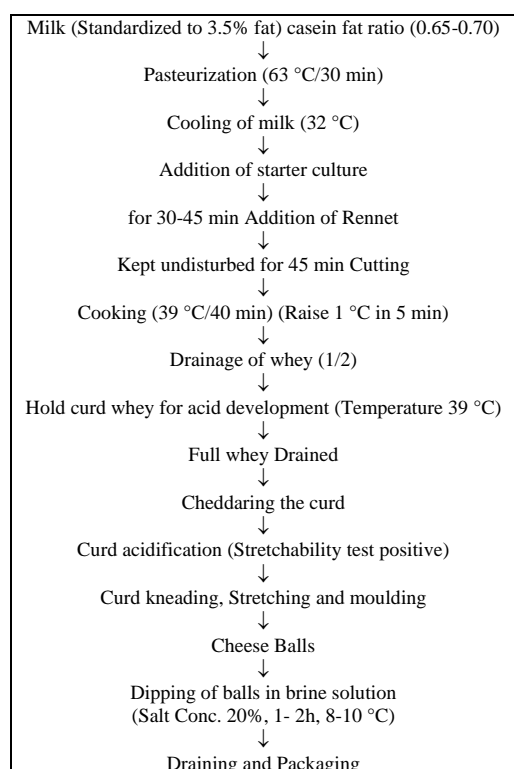


Fig 1: Flow diagram for preparation of pizza cheese (Mozzarella)

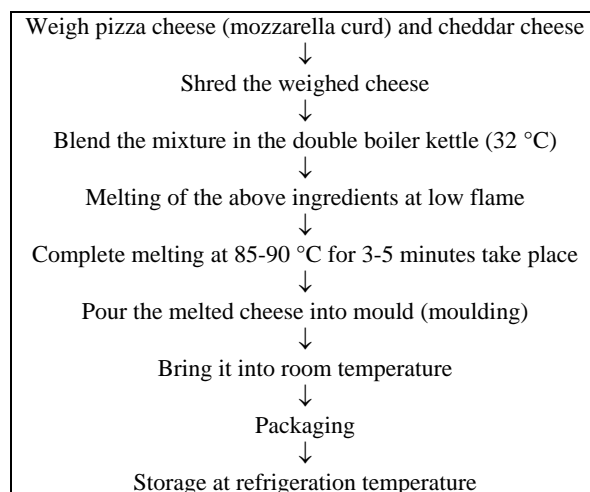


Fig 2: Flow diagram for preparation of Pizza Cheese (Processed)

### Sensory, Physico-chemical, and microbiological analysis of the Pizza Cheese (Mozzarella) & Pizza Cheese (Processed)

Sensory evaluation of the pizza cheese was done using 9-point hedonic scale. The physico chemical attributes such as ash, titratable acidity, fat, protein, total solids, salt content, (AOAC, 2016) [6] and carbohydrate by difference method. The water activity, pH of cheese was determined using water activity meter (Aqua Lab, Series 4TE) and pH meter respectively. Yeast and mold count and coliform count were recorded using the media potato dextrose agar (PDA) and MacConkey agar respectively.

## Results and Discussion

### Development of pizza cheese (mozzarella)

Mozzarella cheese is the one of the important varieties of cheese because of its primary use on the pizza topping (Kindstedt *et al.*, 2010) [7]. It also owns a unique property of forming fibres or strings when hot called stretchability which is required for preparing a variety of food items especially as a topping on Pizza. Pizza cheese was prepared following the recipe given by (Syed and Ghosh 2017) [5]. However, to evaluate the effect of certain treatments on sensory properties of cheese, the process variables were modified.

### Altered fat percentage for pizza cheese (mozzarella) preparation

The milk fat was altered evaluating the effect of % fat on sensorial properties of cheese. It was prepared with varying levels of milk fat *i.e.* 1.5, 3.5, and 4.5%. The fat content of Mozzarella cheese was determined by adjusting the casein-to-fat ratio of milk. The fat-in-dry matter (FDM) of Mozzarella was kept typically 35%. The results have been depicted in Table 1.

Table 1: Effect of varied % fat of milk on sensory properties of pizza cheese\*

Sensory Parameters	Fat		
	(1.5%)	(3.5%)	(4.5%)
Colour and appearance	6.93±0.59 <sup>c</sup>	8.51±0.75 <sup>b</sup>	8.60±0.80 <sup>a</sup>
Body and Texture	6.21±0.12 <sup>c</sup>	8.25±0.18 <sup>b</sup>	8.57±0.26 <sup>a</sup>
Flavour	6.43±0.27 <sup>c</sup>	8.31±0.39 <sup>b</sup>	8.55±0.16 <sup>a</sup>
Mouth feeling	6.15±0.14 <sup>c</sup>	8.33±0.12 <sup>b</sup>	8.65±0.25 <sup>a</sup>
Saltiness	6.25±0.54 <sup>c</sup>	8.23±0.12 <sup>b</sup>	8.35±0.25 <sup>a</sup>
Overall acceptability	6.35±0.07 <sup>c</sup>	8.38±0.12 <sup>b</sup>	8.52±0.07 <sup>a</sup>

\*Means with different superscripts differ significantly ( $p < 0.05$ )

From the sensory scores, it was found that the colour and appearance score of fat 1.5% was lesser than 3.5 and 4.5% due to less fat led to dull appearance of the product. The pizza cheese prepared with 1.5% fat was too hard and rubbery in nature whereas the mouthfeel scores of fat 3.5 and 4.5% were better than 1.5% fat. The decreasing the fat content of cheese invariably resulted in physical and flavour changes, that led to unacceptable quality product and also the low-fat Mozzarella cheeses reported to often tend to be tough and rubbery whereas fat 4.5% showed an excessive fat leakage and also the texture was too soft to store further. The increased fat content of mozzarella cheese increased the softness and meltability, while shred quality tended to be impaired. Overall, pizza cheese with fat% 3.5, resulted in smooth texture. Even though, 4.5% fat was a well-accepted product by the consumers, 3.5% fat in milk was selected for Pizza cheese preparation, keeping in view of additional fat from vegetable oil source going to fortified further in the form of omega-3 oils. The colour and appearance, flavour, mouth feel, saltiness and over all acceptability scores differed significantly ( $p < 0.05$ ). Therefore, based on the preliminary trials, 3.5% fat was selected for preparation of pizza cheese.

#### Pizza cheese (Processed)

Processing of cheese led towards better incorporation of fortificant in the cheese matrix, reducing the free moisture content of pizza cheese simultaneously and has been advocated by many researches (Jana, 2011)<sup>[4]</sup>. With the aim to fulfill this objective, processing of pizza cheese was undertaken and therefore two different variants were mixed namely mozzarella cheese and cheddar cheese. For better amalgamation, curd of mozzarella cheese was combined with cheddar cheese in different proportions. Without any substitution 100% pizza cheese exhibited drastic fat separation and hindered acceptability. Various substitutions tested fell in the range of 50:50, 25:75 and 75:25. However, during the preparation of pizza cheese (processed) using the blends pH of the mozzarella cheese curd played a major role. Mozzarella cheese curd were studied at different pH viz 5.2, 5.3, 5.4 and 5.5 during preparation of pizza cheese (processed) using mozzarella cheese curd and cheddar cheese blend. It was observed that pizza cheese (processed) prepared with mozzarella cheese curd (pH 5.2, 5.3, 5.4) and cheddar cheese blend showed poor blending properties and significant

oil separation. However, when mozzarella cheese curd pH was set at 5.5 and added with cheddar cheese showed good blending and melting properties. Therefore, for the optimization of manufacture of pizza cheese (processed) pH of the mozzarella cheese curd was preferred to be 5.5. Finally, 75:25 combination showed best results and was undertaken into consideration for further preparation. The procedure to prepare pizza cheese (processed) could be retrieved vide Figure 2 as mentioned.

#### Incompatibility of pizza cheese (processed) employing Mozzarella cheese alone

Mozzarella cheese curd tended to form free oil upon melting and the excessive free oil in Mozzarella cheese was a major quality problem during functional pizza cheese manufacturing. The possible phenomenon behind this could be due to occurrence of collapsing of the casein matrix during heating, allowing the fat globules to coalesce and to flow to the surface. The addition of emulsifiers in decreasing the oiling off of the cheese (Suliman *et al.*, 2013)<sup>[8]</sup>. Compared to Mozzarella cheese made in a conventional cooker, cheese produced in a high-pressure, twin-screw extruder yielded product having retarded meltability and less free-oil formation was recommended. (Kindstedt *et al.*, 2010)<sup>[7]</sup>.

#### Sensory Scores of pizza cheese (mozzarella) and Pizza Cheese (Processed)

The sensory scores of Pizza cheeses (Mozzarella and processed) are shown in Table 2. From the sensory analysis score, the colour and appearance of pizza cheese (mozzarella) and pizza cheese (processed) no significant difference was observed. The other sensory parameters like body and texture, flavor, mouth feeling, saltiness and overall acceptability scores were higher for the pizza cheese (processed). This might be due to Mozzarella and ripened Cheddar cheeses, which is a useful process to enhance the flavor characteristics and also biochemical changes that occur in ripened Cheddar were responsible for the enhanced flavor of Pizza cheese. All the sensory scores were significantly different from each other ( $p < 0.05$ ). The biochemical reactions were deciding factor for acceptability. (Banville *et al.*, 2013)<sup>[9]</sup>.

The Physico chemical, fatty acid, microbiological parameters of Pizza cheeses (Mozzarella and processed) are shown in Table 2.

**Table 2:** Comparative study; Pizza cheese (control) and Pizza Cheese (Processed)\*

Sensory Evaluation	Pizza Cheese (Control)	Pizza Cheese (Processed)
Colour and appearance	8.51 <sup>a</sup> ± 0.75	8.65 <sup>a</sup> ± 0.55
Body and Texture	8.25 <sup>b</sup> ± 0.18	8.5 <sup>a</sup> ± 0.18
Flavour	8.01 <sup>b</sup> ± 0.39	8.31 <sup>a</sup> ± 0.29
Mouthfeel	8.33 <sup>b</sup> ± 0.17	8.76 <sup>a</sup> ± 0.52
Saltiness	8.23 <sup>b</sup> ± 0.19	8.46 <sup>a</sup> ± 0.29
Overall acceptability	8.38 <sup>b</sup> ± 0.12	8.5 <sup>a</sup> ± 0.42
Proximate Composition		
Moisture (%)	48.85 <sup>a</sup> ± 0.024	46.55 <sup>b</sup> ± 0.044
Fat (%)	19.88 <sup>b</sup> ± 0.048	23.90 <sup>a</sup> ± 0.057
Protein (%)	23.48 <sup>a</sup> ± 0.053	21.47 <sup>b</sup> ± 0.016
Total carbohydrates	3.68 <sup>a</sup> ± 0.026	3.88 <sup>a</sup> ± 0.024
Minerals*(inclusive of salt content)	4.11 <sup>a</sup> ± 0.034	4.2 <sup>a</sup> ± 0.028
Salt content*(%)	1.42 <sup>a</sup> ± 0.057	1.52 <sup>a</sup> ± 0.028
Titrateable acidity (%)	1.26 <sup>b</sup> ± 0.02	1.41 <sup>a</sup> ± 0.018
pH	5.69 <sup>a</sup> ± 0.015	5.6 <sup>b</sup> ± 0.012
Meltability (cm)	8.9 <sup>a</sup> ± 0.039	6.9 <sup>b</sup> ± 0.024
a <sub>w</sub>	0.9676 <sup>a</sup> ± 0.024	0.9656 <sup>b</sup> ± 0.021

Fatty acid analysis (g/100 g cheese)		
ALA	0.09 <sup>a</sup> ±0.011	0.09 <sup>a</sup> ±0.016
EPA	Nil	Nil
DHA	Nil	Nil
Microbiological Parameters		
Coliform	Nil	Nil
Yeast and mould	Nil	Nil

\*Means with different superscripts differ significantly ( $p < 0.05$ )

### Fat

The fat content differed significantly between the Pizza cheese (mozzarella) and Pizza cheese (processed) due to addition of cheddar cheese and method of preparation. The Milk fat content of the control and processed samples were within the limits of FSSR (2011) <sup>[10]</sup>.

### Protein content

The protein content of Pizza cheese (mozzarella) and Pizza cheese (processed) was 23.48 and 21.47%, respectively. The results were correlated with the findings of Kindstedt *et al.* (2010) <sup>[7]</sup>.

### Titrateable acidity and pH value

The Pizza cheese (mozzarella) and Pizza cheese (processed) titrateable acidity varied in the range 1.26 to 1.41% lactic acid. Whereas the corresponding pH value were 5.69, 5.60 respectively. The similar trends of results were reported by Kindstedt *et al.* (2010) <sup>[7]</sup> stated that pH of the processed cheese sample was 5.61 whereas the titrateable acidity was 1.21 on the day of production.

### Ash content inclusive of salt content

The ash content of the Pizza cheese (mozzarella) and Pizza cheese (processed) were in the range of 4.11-4.2%. The higher ash content of different cheeses is because of added emulsifiers and salt content present in the cheese. The salt content of Pizza cheese (mozzarella), pizza cheese (processed) was 1.42 and 1.52%, respectively. The variation in the salt content of Pizza cheese (mozzarella) and Pizza cheese (processed) samples might be attributed to the increase in total solids of cheese. The values observed were also differed statistically significantly ( $p < 0.05$ ) between the samples. Similar type of results reported by Zaky (2014) <sup>[11]</sup> and stated that the salt content ranges between 1.170 and 1.345%.

### Meltability

Meltability is the capacity of cheese particles to flow together and form a uniform continuous melt. It is an important character which uses to determine the quality of Mozzarella cheese especially used for Pizza pie. Therefore, with the increase in meltability, the quality of Mozzarella cheese improves. The amalgamation of cheese improved stringiness due to better emulsification of fat in amalgamated Pizza cheese that evenly surrounds the protein network and formed channels during heating of cheese. These channels allowed the formation of protein fibers and separated them consequently produces the Pizza cheese with better stringiness characteristics. The appreciably higher scores for meltability and oiliness of amalgamated Pizza cheese (mozzarella) and Pizza cheese (processed) were due to the result of substantial difference in protein hydration in both kinds of cheese. The emulsifiers' treatment increased markedly the meltability of resultant cheese (Kindstedt *et al.*,

2010) <sup>[7]</sup>.

### Total carbohydrate content

The total carbohydrates content for Pizza cheese (mozzarella) and Pizza cheese (processed) were in the range of 3.68 to 3.88%. Similar types of results were mentioned by Giri *et al.* (2017) <sup>[12]</sup>.

### Omega 3 Fatty acids

Omega 3 fatty acids values particularly ALA is present 0.09 (g/ 100 g of cheese) present in both Pizza cheese (mozzarella) and Pizza cheese (processed) samples. Milk fat is one of the most complex of all natural fats contains about 400 different fatty acids. Poly-unsaturated fatty acids (PUFA) 2.3% by weight of the total fatty acids contains 1.6% linoleic acid (18:2) and 0.7% of alpha-linolenic acid (ALA: 18:3) by weight of the total fatty acids. The results were correlated with the findings of Manuelian *et al.* (2017) <sup>[13]</sup>.

### Microbiological parameters

Coliform and Yeast and mold count were absent in all types of product might be due to processing temperature, usage of sterilized packaging materials, equipments and GMP/GHP followed during product preparation.

### Conclusion

From the obtained results, it can be concluded that Pizza cheese (mozzarella) and Pizza cheese (processed) is a viable option of dairy product *i.e.* comparing both the cheeses with intact sensory and proximate parameters. As compared to Pizza cheese (mozzarella), Pizza cheese (processed) have more acceptability than alone. All the parameters were within the limits of FSSAI standards. The comparative study of these Pizza cheese varieties from the mixed milk helped to understand the properties for further improvements, which will be helpful for the academicians and entrepreneurs.

### Conflict of interest

None of the authors has any conflict of interest

### References

1. Anonymous. Cheese Concentrate Market 2022 Key Players, End User, Demand and Consumption by 2027 Read more: <https://www.digitaljournal.com/pr/cheese-concentrate-market-2022-key-players-end-user-demand-and-consumption-by-2027#ixzz7RMLZVyRJ>. 2022(Accessed on 15.5.2022).
2. Anonymous. Food and agribusiness advisory and research, Dairy Sector in India: Opportunities in key states and products. (<http://www.agroberichtenbuitenland.nl/india/Final-Dairy-report-Updated-file-12-oct-16.pdf>).2016 (Accessed on 15.5.2022).
3. Anonymous. Pizza market in India. <https://www.mbarendevous.com/general-awareness/pizza-market-in-india.2019> (Accessed on

- 15.5.2022).
4. Jana AH, Mandal PK. Manufacturing and quality of Mozzarella cheese: A review. *International Journal of Dairy Science*, 2011;6(4):199-226.
  5. Syed MR, Ghosh BC. Texture, Meltability, Color and Sensory Properties of Processed cheese as affected by Addition of Inulin. *Indian Journal of Dairy Science*. 2017;70(6):658-664.
  6. AOAC. Official methods of analysis, 20<sup>th</sup> Edition. Association of Official Analytical Chemists, Washington, DC. 2016.
  7. Kindstedt PS, Hillier AJ, Mayes JJ. Technology, biochemistry and functionality of pasta filata/Pizza cheese. *Technology of cheese making*; c2010. p. 330-359.
  8. Sulieman AME, Ali RAM, Razig KAA. Production and effect of storage in the chemical composition of Mozzarella cheese. *International Journal of Food Science and Nutrition Engineering*. 2012;2(3):21-26.
  9. Banville V, Morin P, Pouliot Y, Britten M. Physical properties of pizza Mozzarella cheese manufactured under different cheese-making conditions. *Journal of Dairy Science*. 2013;96(8):4804-4815.
  10. FSSR. Food Safety and Standard Regulations. Food Safety and Standard Authority of India, Ministry of Health and Family Welfare, Govt. of India, New Delhi; c2011 (Accessed on 4.4.2022).
  11. Zaky SM. Studies on Some Factors Affecting the Mozzarella cheese Characteristics. PH. D. Thesis, Faculty of Agriculture, Alexandria University; c2014.
  12. Giri A, Kanawjia SK, Singh MP. Effect of inulin on physico-chemical, sensory, fatty acid profile and microstructure of processed cheese spread. *Journal of Food Science and Technology*. 2017;54(8):2443-2451.
  13. Manuelian CL, Currò S, Penasa M, Cassandro M, De Marchi M. Characterization of major and trace minerals, fatty acid composition, and cholesterol content of Protected Designation of Origin cheeses. *Journal of Dairy Science*. 2017;100(5):3384-3395.