iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.37076

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

Review: Basic Ingredients of Cottage Cheese Manufacturing

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Abstract: ***The present review evaluated the composition and parts of the cottage cheese which was collected from the Pondicherry, India local cottage cheese making areas. The cottage cheeses are marked for the further studies. In cheese making, milk is the (either cow milk or goat milk) foremost ingredient. In ancient times, cheese was making by using goat milk. The past four decades, cheese needs are increasing due to the low fat and taste of it. Now a day, varieties of cheese was produced using various chemicals and additives. In cheese making industries during ripening and cutting is the main process. In this review focus the ingredient and substitutes of the cheese.***

Keywords: cottage cheese, cow milk, goat milk, ripening of cheese.

I. INTRODUCTION

The familiar “Grana Padano” and “Parmigiano Reggiano" is collectively called as common cheese in cottage industries. In compliance with PDO, grana cheeses have an extended ripening period; from 9 months for normal, up to many years for premium goods. Cheese production relies on the action of bacteria, yeasts and filamentous fungi (ff) which convert the processed milk into cheese, contributing to its final characteristics like consistency, taste, and flavour. There are two types of starter culture have been used for making of cheese production, i.e.

1) The primary microbiota is mainly composed of starter lactic acid bacteria;
2) The secondary microbiota includes salt-tolerant bacteria, yeasts, and filamentous fungi which perform degradation of proteins, sugars and lipids.

In this type of cheese, the development of filamentous fungi usually occurs during ripening and it is only limited to the crust like the most of cheeses [1].

In recent years, there is an ever-increasing interest among consumers for food products that contain less total fat, saturated fat, cholesterol and calories. Cheese analogues are able to meet special dietary needs and can act as a vehicle for a health supplement, e.g. cholesterol-free and enriched with vitamin, mineral, fibre, [2].

Filled cheese is a type of cheese in which milk fat is partly or fully replaced by vegetable oils, which in turn could be partially hydrogenated to impart eating profile similar to that of milk fat. Filled cheeses are often made to possess required quantum of fat through the use of healthful vegetable oils. A directly acidified, low-cholesterol filled-Mozzarella cheese has been made up of skimmed milk emulsified with sunflower-seed oil (Anusha. N et al 2018).

II. LITERATURE REVIEW-BASIC INGREDIENTS USED FOR CHEESE MANUFACTURING

A. Milk

Milk is the basic ingredient used for cheese making, and its physical, chemical and microbiological properties affect the composition and acting on the properties of the cheese. Milk from various mammal species has been used for manufacturing cheese;

1) Goat's milk
2) Cow’s milk is commonly used milk for cheese production.

The cheese-making process will depends on more or less on the composition of the milk [3]; [4].

Table 1. Composition of goat's milk and cow's milk [4].

Constituent %	cow's milk %	goat's milk
Fat	3.80	4.24
Protein	3.35	3.70
Lactose	4.75	4.51
Ash	0.70	0.75
Total Solids	12.60	13.18
Water	87.40	86.82

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B. Pasteurization

The heat applied treatments to exploit before cheese making and have treated with some conditions are;

1) 63°C for30°C minutes or (soft cheese)
2) 72°C for 15 seconds (hard cheese)[5].

C. Microbiological effect

Pasteurization destroys pathogens and bacteria to reduce the load of micro-organisms which might otherwise compete with starter culture bacteria for nutrients [6]. Common milk-borne pathogens like *Campylobacter* and *Salmonella* are among the organisms destroyed [4].

D. Fermentation

Lactic acid bacteria *Lactococcus lactis* ssp obtain metabolic activities anaerobically by catabolic reactions during which lactose is converted to carboxylic acid and energy [7].

E. Curd formation

The normal pH of milk is about 6.6, at the pH of about ~ 4.6, coagulation of the casein occurs. The calcium ions are released and that they form a network with casein molecu1es [5]

F. Rennet coagulation.

1) Proteolysis by chymosin (or the other protease present)
2) Slight acidification
3) Heat application (35°C)
4) Increase in factor IV concentration

G. Cutting technique

In ancient cheese cutting methods Swords and tree branches were used [8]. A knife is carefully inserted into the curd in an upright position, steadily pushed forward from one side of the vat to the opposite. The horizontal wire knife is used first, only in one direction, lengthwise, whereas the vertical wire knife is applied in two directions, the long and thus the cross-cut [8].

H. Salting

In past, traditionally process cheese was preserved in seawater, while in commercial manufacturing, the curd is dry salted with coarse salt or brine salted. The salt sprinkled on the surface of the curd dissolves within the moisture. Through the diffusion process, salt penetrates the curd and conversely, water (whey) migrates outwards. The speed of salt absorption and thus the ultimate salt content depends on factors just like the geometry of the curd, pH, temperature and moisture content [9]

I. Ripening

During ripening, biochemical reactions occur which enhance the unique flavour, aroma and textural properties of cheese. The first reactions that occur involve proteolysis and lipolysis[10].

J. Rennet substitutes

According to [9], a shortage and corresponding expense of mammalian rennet has led to the utilization of proteolytic enzymes from microorganisms like *Mucor miehei*, *Mucor pusil* and *Endothia parasitica* as substitutes. However, these enzymes are much less specific in hydrolysis (less specific to Phe105 - Met106 bond) and hence affect the standard of the resultant cheese adversely. This is often thanks to the very fact that, unlike the mammalian proteinase which contains a little fraction of pepsin additionally to chymosin, microbial enzyme is only chymosin. Consistent with, microbial proteinase was successfully utilized in place of rennet for manufacturing many sorts of cheeses including Feta. Although the Feta cheese had almost an equivalent composition and organoleptic properties because the mammalian rennet cheese, its rate of whey drainage was slightly slower. After slight alterations within the Feta cheese making technique were made, the cheese had better moisture content.

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ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
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III. CHEESE ANALOGUES

Cheese analogues, also mentioned as cheese substitute or imitations, are the products that partly or wholly substitute or imitate cheese and during which milk fat, milk protein [1]. Cheese analogues are the products made out of dairy, partial dairy or non-dairy ingredients, which tend to resemble the actual natural cheese counterpart. They are being used increasingly due to their cost-effectiveness, simplicity of their manufacture and storage stability.

A. Dairy

It is made using casein, caseinates, milk protein concentrates, total milk proteinate, cream, anhydrous milk fat of dairy origin alongside other functional ingredients and cheese flavouring[11].

B. Partial dairy

During this, the fat source is oil (e.g. soya oil, palm oil, rapeseed oil and their hydrogenated equivalents) and protein source is dairy-based (usually rennet casein and/or caseinate) along with other requisite ingredients[2].

C. Non-dairy/Synthetic

It's made using both fat and protein of vegetable origin. Cheese analogue is formed out of formulation containing a protein and fat source alongside functional additives (viz., acid, emulsifying salts, common salt, emulsifier and stabilizer) alongside flavouring, mold inhibitor and colourings[4].

D. Protein source

The protein component in a cheese analogue stabilizes the oil-in-water emulsion by reducing the interfacial tension at the aqueous phase-oil droplet interface and by increasing the viscosity of the aqueous phase, thereby decreasing the frequency of collisions between oil droplets[12].

E. Casein

Acid casein or rennet casein is the major protein source of dairy-based analogue cheeses is. Powdered rennet casein may be considered as a young dried skim milk cheese consisting of para-casein cross-linked by calcium. Acid casein-based cheese analogue exhibited better emulsification properties and meltability employing disodium phosphate as emulsifying salt than that supported rennet casein. Cheese analogue has also been made using a combination of acid and rennet casein (1:1); the total casein content in the product was 15-30%[13]. The characteristics sought after in caseinates for preparation of cheese analogues include quick hydration and dispersion, adequate swelling properties, optimal protein-protein interaction and retaining the pseudo-plastic behaviour over a range of shear rates. The caseinate having higher content of ash, fat, lactose, non-casein protein, calcium, phosphorus and lower water absorption and stability to added calcium were found to be functionally better for preparation of cheese[14].

F. Peanut protein

Among various vegetable sources, peanut shows potential as a source of both protein and oil. However, most of the peanut cheese-like products are prepared by ripening methods using microbial inoculation. A quick and simple non-fermentation method was reported for the production of a cheese-like matrix from PPI. Curd made up of peanut milk has been utilized in the preparation of processed cheese-like spread[5].

G. Fat source

The role of fat in cheese is to contribute to its physical characteristics by giving opacity and influences the rheology of cheese. Fat acts as the precursor of many flavour compounds and it modifies their perception and volatility, especially in the mouth. Fat globules normally act as filler between proteins fibres, reducing the interactions among proteins within the cheese matrix[2]. The level of fat used in cheese has a direct impact on product acceptability.

H. Milk fat

Processed cheese analogue based on rennet casein has been prepared using AMF (27% in the formulation) and/or white butter as the fat source. The recommended casein: butter ratio was 77:23 [15]. Processed cheese analogues supported high protein skim milk powder and ultrafiltrated retentate are often made to possess more creamy and buttery flavour by using AMF as fat source.

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I. Stabilizers

Using of carrageenan, this interacts strongly with the casein helps in enhancing the body, texture and emulsification of the analogue product, especially having a low content of cheese proteins. Replacement of gum arabic with XG, LBG mixture overcame the surface stickiness problem encountered with the use of gum arabic alone[16].

J. Emulsifier

In cheese analogue emulsification plays a key role in deciding the functionality of the product. Several emulsifiers such as lecithin, tween-80, decaglycerol decaoleate, a mixture of mono- and di-glycerides, lactylate monoglycerides, polyoxyethylene mono-and di-glycerides of fatty acids, etc. have been used in the preparation of imitation cheese for emulsification and dispersion of fat/oil in the protein matrix. Emulsifiers having high hydrophilic-lipophilic balance and that is fluid at ambient temperature are the preferred ones. The inclusion of such an additive during processing resulted in improved mixing and consequently less oiling-off during baking[15].

K. Emulsifying salts

The role of emulsifying salt is to improve the emulsifying capacity of the protein present in casein and cheese. Emulsifying salts generally comprise of a monovalent cation (i.e. sodium) and a polyvalent anion (e.g. phosphate). The most commonly used emulsifying salts include sodium citrates, sodium orthophosphates, sodium polyphosphates, di-sodium phosphates and blends of phosphates and citrates or several phosphates only.

IV. DIVERSE FUNCTIONALITY AND STABILITY

Cheese substitute offers diversity in functionality (e.g. shredability, flowability, melt resistance) made possible by their tailor-made formulations, including their high functional stability during storage. Many cheese makers produce Mozzarella imitations characterized by their melting and free-running properties, primarily for use in pizzas.

A. Preservatives

Sorbic acid and potassium sorbate (0.09-0.15%) are used as a mycostatic agent.

B. Flavourings

Flavorings compounds available within the sort of liquid, dry powder or oil based are utilized in cheese analogues, some being artificial whereas others could also be of natural origin such as EMC flavor. EMC is defined as concentrated cheese flavor, produced enzymatically from cheeses of varied ages and are principally used as an ingredient in processed foods, analogue cheese and cheese spreads. Cheese flavoring has been used at levels of 1.0 to 5.0 per cent. Lower pH (i.e. pH of 5.5) enhances the flavor intensity of imitation cheese flavored with EMC; the extent of lipolysis in EMC also affected its flavor profile.

C. Miscellaneous Additives

Various colorants have been used in the cheese formulation to improve the appearance and acceptability of the cheese analogue. Vitamin mineral premix and color has been used at the rate of 0.10% and 0.03% respectively (Rule *et al*., 1978). Calcium chloride has been used at the rate of 0.97 and 0.36.

V. SUMMARY AND CONCLUSION

Market of cheese in India is 1250 crores in 2013 and forecasted to grow at rate of 20% annually (articles.economicsimes.indiatimes.com). The total consumption of cheese in India is about 7,500 tons. The per capita consumption of cheese in India is 2.5 kg per annum as against 16.0 kg per annum in US. Anand Milk Union Limited (AMUL), one of the pioneers in introducing Mozzarella cheese commercially in India has a large contribution to the cheese market in India. Amul's annual sale of Mozzarella cheese was about 800 tons in 2001. Amul has captured about 55.0 per cent share in the Rs. 70 crores industry cheese markets. Fungal growth on cheese is a common problem for the cheese manufacture during ripening and curing as well as for the retailer and consumer during refrigeration storage. Species of *Penicillium* and *Aspergillus* are common contaminants of cheese. By the searching in the medical references, it was observed that, most of these fungi had the ability to human and animal pathogenicity or produced toxins. The growth of toxigenic fungi during ripening of cheese must be considered as a problem of safety for human consumption. During the ripening of cheese, non-toxigenic strains of fungi should be avoid, moreover, fungi growth on the cheese surface causes economic losses and quality problems. In this study concluded that how the cottage cheeses are contaminated by pathogenic fungi and mold.

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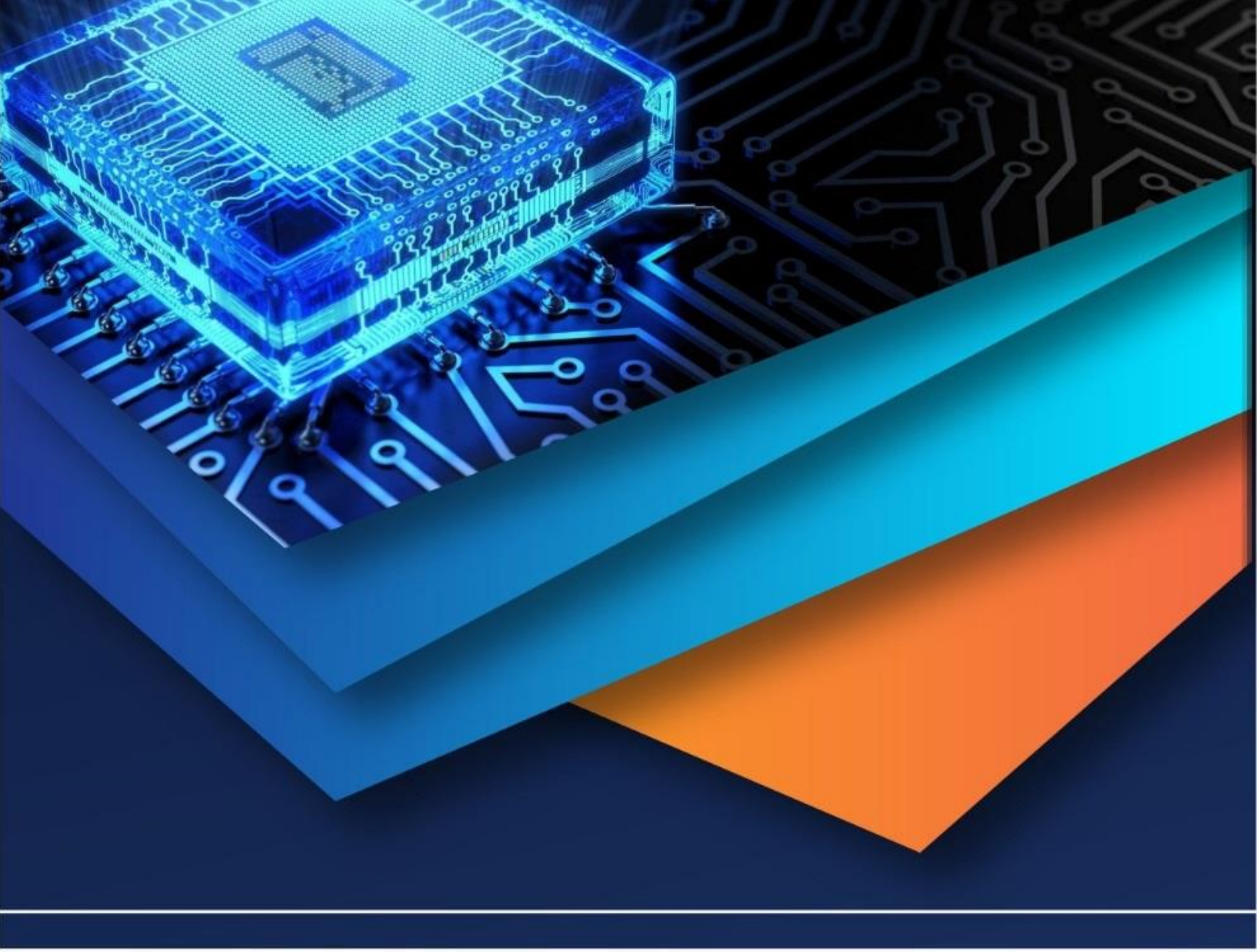
VI. ABBREVIATION

1) PDO - Protected Designation of Origin certification
2) PPI - Peanut Protein Isolate
3) AMF - Anhydrous Milk Fat
4) XG - Xanthan Gum
5) LBG - Locust Bean Gum
6) EMC - Enzyme Modified Cheese

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