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Processed Cheese: What is that Stuff Anyway?

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Processed cheese is made from natural cheeses that may vary in degree of sharpness of flavor. Natural cheeses are shredded and heated to a molten mass. The molten mass of protein, water and oil is emulsified during heating with suitable emulsifying salts to produce a stable oil-in-water emulsion. Depending on the desired end use, the melted mixture is then reformed and packaged into blocks, or as slices, or into tubs or jars. Processed cheeses typically cost less than natural cheeses; they have longer shelf-life, and provide for unlimited variety of products.

The literature on processed cheese until now has been somewhat limited because earlier research has been done in companies and held as trade secrets or were protected by United States patents. Today, almost all initial patents on processed cheese have expired providing opportunities for new developments. There has been renewed interest in processed cheese due to the food industry's need for tailor made cheeses with consistent quality and functionality as well as consumer needs for cheese products beyond natural cheeses. Processed cheese provides an opportunity to meet these needs. Today processed cheese is one of the leading cheese varieties worldwide (1).

Some Historical Background

Although somewhat uncertain, the origins of processed cheese are thought to date back to Swiss cheese fondue, German Kochkase (cooked cheese), French Cancoillotte or Canquillotte and Welsh Rarebit. Kochkase and Cancoillotte were made with coagulated sour milk or skimmed milk; Fondue was made from Swiss cheese, which is a rennet cheese. Soda was added in the preparation of Kochkase, and eggs were used to make Cancoillotte. Wine and/or beer were used to prepare Fondue.

Commercially, the first processed cheese was developed by Walter Gerber and Fritz Stettler in Switzerland in 1911. In this process, natural Emmentaler cheese was shredded and heated with sodium citrate to produce a homogeneous product which firmed up upon cooling. The initial intent of this product was to improve shelf-life of cheese shipped to warmer climates. About this time, James Lewis Kraft in the United States of America (USA) was working independently on blending and heating of natural cheeses. The first patent, which was issued to him in 1916, describes melting pieces of Cheddar cheese and stirring it while heating to form a homogenous warm cheese which was then packaged in glass jars or cans (2). This first patent did not describe addition of emulsifying salts and/or other ingredients during

processing. The use of emulsifying salts (sodium phosphate) was described later for the first time in 1921 in a patent issued to George Herbert Garstin of the Phoenix Cheese Company (3).

In another patent issued to Kraft in 1921, packaging of a 2.27 kg loaf was described, which was a significant breakthrough for the distribution of process cheese (4). It is believed that the 2.3 kg loaf was responsible for nearly doubling of processed cheese consumption in the USA during this time period. Later, several other patents were issued that described processing and packaging methods and equipment. In 1927, Wheeler & Scott were issued a patent in which they describe a lay-down cooker that claimed for rapid and uniform heating of the cheese during manufacturing (5). This equipment later evolved to the jacketed kettle and, in 1935, Norman Kraft was issued a patent for a lay down cooker that provided for heating the cheese by direct injection of steam into the product (6). However, direct injection of steam for cooking incorporated added moisture, which then needed additional monitoring to assure that the cheese did not exceed its legal moisture limits.

Over the years, other gradual improvements included modifications to the cookers for improved and more uniform heating, and changes to mixing configurations for more uniform mixing of the ingredients and enhanced emulsification. Improvements to the process control resulted in more uniform quality product. During this time, there was also a concurrent development in the manufacture of cheese slices and other convenient forms of processed cheese and related products. In the 1940s and early 1950s, methods and equipment for continuous forming of processed cheese slices were developed. Norman Kraft filed a patent in 1940, which was issued in 1944 that described the production of processed cheese slices. In this process, hot processed cheese was transferred onto a pair of cooling drum rolls. The thin sheet of cheese that was produced was then transferred onto a conveyor where it was cut into ribbons and then cross cut again to form the processed cheese slices (7). These cheese slices were flexible, and had a glossy smooth finish. The process prevented the slices from sticking together as well as sealing in the flavour of freshly produced cheese. This was a significant breakthrough in terms of convenience, replacing the cheese loaf as the major type available to consumers. At present, processed cheese slices account for 74% of total sales at the supermarket in the USA (8).

By the 1950s, several other procedures were developed to fill the demand for sliced cheese. The most significant one was the invention of the individually wrapped slices. Other developments included type and quality of the ingredients used for processed cheese manufacturing. In 1950, standards of identity for processed cheese were established by the United States Food and Drug Administration (FDA). At this time, it was also required that the optional ingredients be declared on the label. In 1974, enzyme modified cheeses (EMC) were approved as optional ingredients for the manufacture of processed cheese. EMC provided for accelerated ripening of natural cheeses to enhance flavor levels in processed cheese. They reduced costs associated with storage, and investment of natural cheese inventory. They also provided specific flavors, flavor intensities and uniformity to meet specific processing needs. In 1973, standards of identity for cheese analogues and imitation cheeses were established by FDA (9).

Processed Cheese and Products

Standards of identity define the product, its composition, and the types and levels of ingredients allowed, for processed cheese products and analogues and vary depending on the country. In the USA, they are found in the Code of Federal Regulations (CFR) Title 21 (10). There are also International Codex Alimentarius Standards for processed cheese varieties. In

the USA, three main categories of processed cheese and products are defined. The box below summarizes the characteristics of these different categories of processed cheese and related products. They differ based on requirement of minimum fat content, maximum moisture content minimal final pH, and optional ingredients that can be used. 'Pasteurized Process Cheese' is a dairy product that is produced by mixing and heating of natural cheeses with emulsifying salts to produce a homogeneous plastic mass. This product is cooked typically at about 70-80°C. The final product has the same fat content and not more than 1 % greater maximum moisture content than the corresponding natural cheese. A good processed cheese is smooth and uniform in color, melts uniformly, slices smoothly and has a compact body. 'Pasteurized Process Cheese Food' has the same specifications and ingredients as Pasteurized Process Cheese, but the product contains more moisture, less fat, lower pH and the cooking temperatures are higher. The standard of identity also allows for optional ingredients, which are not permitted in 'Pasteurized Process Cheese'. The final product is softer in body and milder in flavor than processed cheese. Cooking temperatures for this product are around 82°C and organic acids, such as citric, lactic, acetic, phosphoric, are added to decrease the pH level in the product. The final pH of processed cheese should range from 5.2-5.6 (11). 'Process Cheese Spread' is manufactured similar to processed cheese and processed cheese food; however, the incorporation of excess moisture is permitted for better spreadability of the product. This product is cooked to about 88°C and organic acids are used to acidify the product during processing. The same optional ingredients as processed cheese food are allowed. In addition, sweetening agents, starches, and gums/hydrocolloids at a maximum level of 0.8g/100g of the finished product may be used (11). Gums/hydrocolloids provide for additional water binding for this higher moisture product. There are also a variety of additional products and low-fat versions of the above products that do not fit into the above standardized categories. 'Pasteurized Process Cheese Product' is an undefined category for products that do not meet the standards of identity as defined in the CFR. In the 'Pasteurized Process Cheese Product' category there are no limits on the fat and moisture content. This allows for different and innovative milk derived ingredients, and provides more readily for new product development opportunities. Additional ingredients included in the above products include vegetables, meats, fruits, herbs, flavors, colors and spices.

The market share of these products in the USA in 2007 is as follows:- (a) 74% of processed cheese is sold as slices, (b) 20 % as loaves of various sizes, (c) 4.5% as spreads and (d) the remaining 1.5 % as cubed, shredded and grated (IDFA, 2007).

So, next time you would like a cheese that melts uniformly for cheese sauce and over nachos or a cheese slice that makes for a juicy cheeseburger, do consider blocks, or singles of pasteurized processed cheese products, respectively.

Standards of Identity for Pasteurized Process Cheese and Products (FDA, 2006)

Pasteurized process cheese

Ingredients: Contains natural cheeses or enzyme modified cheeses, emulsifying agents (<3 % w/w), acidulants (vinegar, lactic acid, citric acid, acetic acid, phosphoric acid), milkfat (from cream, anhydrous milkfat or dehydrated cream; <5% w/w), water, salt, colors, spices, flavorings, mold inhibitors¹ (sorbic acid, potassium sorbate, sodium sorbate; <0.3% w/w), antisticking agent¹ (lecithin <0.03% w/w). Moisture: < 40 % (w/w); Fat: > 30 % (w/w); pH: >5.3.

Pasteurized process cheese food

Ingredients: Natural cheeses and enzyme modified cheeses (>51% (w/w) of the final products) all of the ingredients allowed in processed cheese, also milk, skim milk, buttermilk and cheese whey. Moisture: < 44 % (w/w); Fat: > 23 % (w/w); pH: > 5.0.

Pasteurized process cheese spread

Ingredients: Natural cheeses and enzyme modified cheeses (>51% w/w of the final products) all of the ingredients allowed in processed cheese food, also food gums, sweeteners, nisin (<250 ppm). Moisture: 44 - 60 % (w/w); Fat: > 20 % (w/w); pH: > 4.0.

¹Slices, or cut in consumer-sized packages

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