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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

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Agenda Item 4 (q) **CX/MMP 06/7/8 Add. 2**

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JOINT FAO/WHO FOOD STANDARDS PROGRAMME

CODEX COMMITTEE ON MILK AND MILK PRODUCTS

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PROPOSED DRAFT STANDARD FOR PROCESSED CHEESE

COMMENTS AT STEP 3

Comments from: IDF

INTRODUCTION

The CCMMP Drafting Group has asked IDF to address specific points regarding the Proposed Draft Standard for Processed Cheese[1]:

1. Provide levels of min. dry matters at different ranges of FDMs
2. To develop a list of functional additive classes within a table approach and corresponding lists of specific additives for each class based on described technological justifications for each class and each additive with a numerical ADI specified, using the approach followed by the CCMMP in the fermented milks standard.
3. To investigate the fat contents of cream as referred to in option ii) under Section 3.1 - Raw Materials Re: 1st paragraph (cheese content) of document CX/ MMP 06/7/8[2] and to provide information on the minimum level used in practice.

1. Levels of min. dry matters at different ranges of FDMs

Discussion

Processed Cheese like products can be produced with almost any composition desired by considered selection of the cheeses, other dairy ingredients and processing techniques used in the product formulation. As a consequence the range of products designated as Processed Cheese at present throughout the world is quite diverse.

Thus technical considerations such as body, texture, flavour and functionality, alone, cannot be used as the sole criterion for setting compositional standards for Processed Cheese.

While the compositional requirements in the standard should reflect the majority of Processed Cheese currently in international trade, it is unlikely that agreement can be reached on compositional standards that cover all products currently manufactured that are designated as Processed Cheese.

The decisions of the CCMMP Drafting Group to take into consideration the existing Standards A-8 (a) and (b), while allowing some greater flexibility as regards Processed Cheese qualified as "spreadable", in the draft standard, should also be reflected as regards compositional requirements.

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1 CX/MMP 06/7/8, para. 28ii, para. 44-45, para. 47-48 and para. 73

2 "….the Drafting Group requested the IDF to investigate which fat contents of cream are typically used for upwards fat standardization in the manufacture of processed cheese"

All the values are in square brackets indicating that these are not definitive levels but are indicative of the values likely to achieve general acceptance.

Recommendation: Appendix I attached contains the IDF proposal in Table form. The request of the CCMMP Drafting Group, to have a limed number of ranges only, is respected.

2. List of Additive Classes, Specific Additives for Processed Cheese

Discussion:

Additive Classes:

Colours, Emulsifying Salts, Acidity Regulators, Preservatives and Emulsifiers:

There is general consensus on the inclusion of these additive classes.

Stabilisers and Thickeners:

The Additive Class, Thickeners, consist mainly of gums and polysaccharides. While these are safe additives, and indeed many thickeners are included in Table 3 of the GSFA at GMP level, nonetheless, on the basis that certain milk based ingredients (e.g. cheese with relatively high levels of non-hydrolysed paracaseinate, caseins, caseinates) can provide the required functional properties, it is proposed that the Additive Class Thickeners is not required for Processed Cheese. In the old Codex Standards covering Processed Cheese, the use of thickeners was confined to Processed Cheese Preparations in Standard A-8(c)[3].

The issue of stabilisers is somewhat different. Their functional role is defined as making it possible to maintain a uniform dispersion of two or more immiscible substances in a food. In line with the general principle, their use should be restricted in order to preserve the image of processed cheese and only those which are not readily replaceable should be included. Therefore it should be discussed to permit the use stabilisers in processed cheeses with high moisture or reduced fat content only. For example DM ≤ [40]% or Fat Contents < [30]%FDM. These values take the Composition Table into consideration. Final decisions have not been taken on the levels and thus they are included in square brackets on the table. As there is not consensus on their inclusion or exclusion, this Additive Class is retained in square brackets.

Anti-Caking Agents:

It is unlikely that anti-caking agents would be required or justified in processed cheese qualified as "spreadable", therefore deletion from this product category is proposed. There appears to be general consensus on the inclusion of the additive class anti-caking agents, for the category processed cheese for use on the surface of sliced, cut, shredded and grated products only.

Specific Additive List:

In preparing the specific additive lists the following issues were considered:

1. The draft standard does not encompass flavoured processed cheese and the additives for that category are contained in, and should be left to, the GSFA.
2. As a general principle, additives not permitted in the GSFA should be omitted from the draft, to overcome subsequent problems with at CCFAC. However, it should be stated that this poses some specific problems in processed cheese. It will be necessary to delete **INS 160c Paprika oleoresins** from the list of colours, as this has not been approved as a colour by JECFA. It is noted that this colour is permitted in the Codex General Standard for Cheese and the IDF advice to the 6th CCMMP on the use of this colour in C-Standards for cheese was accepted. However, problems are more likely at CCFAC.

   Recommendation: To delete this additive from the proposed list, to avoid problems at CCFAC but request the Committee to consider seeking JECFA approval of INS 160c as a colour.

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[3] Codex General Standard for Process(ed) Cheese Preparations (Process(ed) Cheese Food and Process(ed) Cheese Spread) CODEX STAN A-8(c)-1978

3. As regards INS 1105 Lysozyme hydrochloride, this is approved in the GSFA Table 2 as a preservative for Ripened Cheese (Food Category 01.6.2) but not for Processed Cheese. IDF recommend inclusion and point out that it is a safe and suitable additive, its use is functionally justified as a preservative, due to the types of packaging systems used for processed cheeses (where potential anaerobic conditions may apply) and where there is potential for microbiological activity even after heat processing.

   Recommendation: To include INS 1105 Lysozyme hydrochloride at GMP level in the proposal, pending JECFA approval for Processed Cheese.

4. As regards Nisin (INS 234), it is noted that the GSFA has a max. level of 250 mg/kg as the level required to ensure complete effectiveness against Clostridium botulinum in certain high moisture cheese spreads. The proposal is that the 12.5 mg/kg level, used in earlier proposals be retained.

   Recommendation: IDF proposes a max. level of 12.5 mg/kg for Processed Cheese.

Bearing in mind the above, Appendix II appended contains the Table of Additive Classes, and a List of Specific Additives. Additive Justifications are contained in Appendix III.

3. To investigate the fat contents of cream as referred to in option ii) under Section 3.1 - Raw Materials Re: 1st paragraph (cheese content) of document CX/ MMP 06/7/8.

IDF has investigated the extent of use of cream for this purpose among its members. The information received indicates that use of cream may be quite limited.

IDF can report that, in practice, creams used for upwards fat standardization typically have a **minimum content of fat between 25-30%.**

APPENDIX I

Proposal to CCMMP from IDF for min. dry matter levels at different ranges of FDMs in Proposed Draft Standard for Processed Cheese

Process(ed) Cheese and Process(ed) Cheese qualified as "spreadable", shall have a minimum dry matter content related to the declared minimum milk fat in dry matter content, as follows:

Fat in Dry Matter	**Min Dry Matter**	
	Processed Cheese	Processed Cheese qualified as "spreadable"
≥ 50%	**[50%]**	**[40%]**
≥ 30% and < 50%	**[34%]**	**[30%]**
< 30%	**[29%]**[4]	**[25%]**

[4] Level in old A-8 (b) Standard (CODEX STAN A-8(b)-1978)and also A-8 (c) Standard (CODEX STAN A-8(c)-1978)

APPENDIX II

SPECIFIC FOOD ADDITIVES FOR PROCESSED CHEESE[5]

4 FOOD ADDITIVES

Only those additives classes indicated in the table below may be used for the product categories specified. Within each additive class, and where permitted according to the table, only those individual additives listed may be used and only within the limits specified.

[In accordance with Section 4.1 of the Preamble to the General Standard for Food Additives (CODEX STAN 192 - Rev. 2-1999), additional additives may be present in the flavoured processed cheese as a result of carry-over from non-dairy ingredients.]

Additive Class	Processed Cheese	High Moisture [≤40%DM] or Reduced Fat [<30% FDM] Processed Cheese
Colours	X	X
Emulsifying Salts	X	X
Acidity Regulators	X	X
Preservatives	X	X
Emulsifiers	X	X
[Stabilisers]	-	[X]
Anticaking Agents	X[6]	-

Colours

INS No.	Additive Name	Max. level	Comments
101i,ii	Riboflavins	300 mg/kg	See [7]
140	Chlorophyll	15 mg/kg	} used singly or
141i, ii	Chlorophylls, Copper Complexes	15 mg/kg	} in combination
160a (i)	Beta-Carotene (Synthetic)	25mg/kg	
160a (ii)	Carotenes (Vegetable); Natural Extracts	600 mg/kg	Changed level in line with GSFA
160b	Annatto Extracts	15 mg/kg	Calculated as bixin
160e	beta-Apo-8'-Carotenal	35 mg/kg	
160f	beta-Apo-8'-Carotenoic Acid, methyl and ethyl esters	35 mg/kg	

Emulsifying Salts

INS No.	Additive Name	Max. level	Comments
325	Sodium Lactate	GMP	
327	Calcium Lactate	GMP	
330	Citric Acid	GMP	
331i-iii	Sodium Dihydrogen Citrate; [Disodium Citrate[8]]; Trisodium Citrate	GMP	
332i,ii	Potassium citrates	GMP	
333	Calcium Citrates	GMP	

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5 The tables of specific additives apply to plain processed cheese only, additional additives required for flavoured processed cheese are left to the GSFA Table 2

6 For the surface of sliced, cut, shredded and grated products only

7 Formerly GMP but changed to 300 mg/kg at Step 3 by 36th CCFAC

8 Subject to JECFA approval for processed cheese

334	Tartaric Acid (L(+)-)	34,900mg/kg	See [9]
335i,ii	Monosodium Tartrate; Disodium Tartrate	34,900mg/kg	”
336i,ii	Monopotassium Tartrate; Dipotassium Tartrate	34,900mg/kg	”
337	Potassium Sodium Tartrate	34,900mg/kg	
338	Orthophosphoric Acid	20,000 mg/kg	} expressed as P_2O_5[10]
			}singly or combined
339i-iii	Sodium Dihydrogen Phosphate; Disodium Hydrogen Phosphate; Trisodium Phosphate	20,000 mg/kg	}expressed as P_2O_5 }singly or combined
340i-iii	Potassium Dihydrogen Phosphate; Dipotassium Hydrogen Phosphate; Tripotassium Phosphate	20,000 mg/kg	}expressed as P_2O_5 }singly or combined
341i-iii	Calcium Dihydrogen Phosphate; Calcium Hydrogen Phosphate; Tricalcium Phosphate	20,000 mg/kg	}expressed as P_2O_5 }singly or combined
343i,ii	Monomagnesium Phosphate; Dimagnesium Orthophosphate	20,000 mg/kg	}expressed as P_2O_5 }singly or combined
450i-vii	Disodium Diphosphate; Trisodium Diphosphate; Tetrasodium Diphosphate; [Dipotassium Diphosphate[11];] Tetrapotassium Diphosphate; Dicalcium Diphosphate; Calcium Dihydrogen Diphosphate	20,000 mg/kg	}expressed as P_2O_5 }singly or combined
451i,ii	Pentasodium Triphosphate; Pentapotassium Triphosphate	20,000 mg/kg	}expressed as P_2O_5 }singly or combined
452i,ii,iv,v	Sodium Polyphosphates, Glassy; Potassium Polyphosphate; Calcium Polyphosphate; Ammonium Polyphosphate	20,000 mg/kg	}expressed as P_2O_5 }singly or combined

Acidity Regulators

INS No.	Additive Name	Max. level	Comments
170i	Calcium Carbonate	GMP	
260	Acetic Acid, Glacial	GMP	
261	Potassium Acetate	GMP	
262i	Sodium Acetate	GMP	
263	Calcium Acetate	GMP	
270	Lactic Acid	GMP	
296	Malic Acid (DL-)	GMP	
297	Fumaric Acid	GMP	
325	Sodium Lactate	GMP	
326	Potassium Lactate	GMP	
327	Calcium Lactate	GMP	
330	Citric Acid	GMP	
331i-iii	Sodium Dihydrogen Citrate; [Disodium Citrate[12]]; Trisodium Citrate	GMP	
333	Calcium Citrates	GMP	

[9] Formerly GMP but max. level stated is that in latest GSFA
[10] The GSFA expresses phosphates as P and max. 14,050 mg/kg
[11] Subject to JECFA approval for processed cheese
[12] Subject to JECFA approval for processed cheese

338	Phosphoric Acid	5,000 mg/kg	}expressed as P_2O_5[13] singly or }combined when used as } acidity regulators however }overall max. level of } 20,000 mg/kg applies
339i-iii	Sodium Dihydrogen Phosphate; Disodium Hydrogen Phosphate; Trisodium Phosphate	5,000 mg/kg	}expressed as P_2O_5[14] singly or }combined when used as } acidity regulators however }overall max. level of } 20,000 mg/kg applies
340i-iii	Potassium Dihydrogen Phosphate; Dipotassium Hydrogen Phosphate; Tripotassium Phosphate	5,000 mg/kg	}expressed as P_2O_5[15] singly or }combined when used as } acidity regulators however }overall max. level of } 20,000 mg/kg applies
341i-iii	Calcium Dihydrogen Phosphate; Calcium Hydrogen Phosphate; Tricalcium Phosphate	5,000 mg/kg	}expressed as P_2O_5[16] singly or }combined when used as } acidity regulators however }overall max. level of } 20,000 mg/kg applies
500i-iii	Sodium Carbonates; Sodium Hydrogen Carbonate; Sodium Sesquicarbonate	GMP	
501i,ii	Potassium Hydrogen Carbonate; Potassium Carbonate	GMP	
575	Glucono delta-Lactone	GMP	

Preservatives

INS No.	Additive Name	Max. level	Comments
200	Sorbic Acid	2,000 mg/kg	} singly or in combination
201	Sodium Sorbate	2,000 mg/kg	} singly or in combination
202	Potassium Sorbate	2,000 mg/kg	} singly or in combination
203	Calcium Sorbate	2,000 mg/kg	} singly or in combination
280	Propionic Acid	GMP	
281	Sodium Propionate	GMP	
282	Calcium Propionate	GMP	
283	Potassium Propionate	GMP	
234	Nisin	12.5 mg/kg	see [17]
301	Sodium Ascorbate	GMP	
302	Calcium Ascorbate	GMP	
1105	Lysozyme Hydrochloride	GMP	

Emulsifiers

INS No.	Additive Name	Max. level	Comments
322	Lecithins	GMP	
471	Mono- and Diglycerides of fatty acids	GMP	

[Stabilisers]

INS No.	Additive Name	Max. level	Comments
[472a]	[Acetic and Fatty Acid Esters of Glycerol]	[GMP]	

[13] The GSFA expresses phosphates as P and max. 14,050 mg/kg
[14] The GSFA expresses phosphates as P and max. 14,050 mg/kg
[15] The GSFA expresses phosphates as P and max. 14,050 mg/kg
[16] The GSFA expresses phosphates as P and max. 14,050 mg/kg
[17] It is noted that the GSFA has a max. level of 250 mg/kg as the level required to ensure complete effectiveness against Clostridium botulinum in certain high moisture cheese spreads

[472b]	[Lactic and Fatty Acid Esters of Glycerol]	[GMP]
[472c]	[Citric and Fatty Acid Esters of Glycerol]	[GMP]
[472e]	[Diacetyltartaric and Fatty Acid Esters of Glycerol]	[10,000mg/kg]
[472f]	Tartaric, Acetic and Fatty Acid Esters of Glycerol (Mixed)]	[GMP]
[473]	[Sucrose Esters of Fatty Acids]	[10,000mg/kg]
[476]	[Polyglycerol Esters of Interesterified Ricinoleic Acid]	[5,000 mg/kg]

Anticaking Agents

INS No.	Additive Name	Max. level	Comments
460i	Microcrystalline Cellulose	GMP	
460ii	Powdered Cellulose	GMP	
551	Silicon Dioxide (Amorphous)	10 g/kg	Calculated as SiO_2 used singly or in combination
552	Calcium Silicate	10 g/kg	Calculated as SiO_2 used singly or in combination
553i	Magnesium Silicate (Synthetic)	10 g/kg	Calculated as SiO_2 used singly or in combination
553iii	Talc		Calculated as SiO_2 used singly or in combination
554	Sodium Aluminosilicate	10 g/kg	Calculated as SiO_2 used singly or in combination
556	Calcium Aluminium Silicate	10 g/kg	Calculated as SiO_2 used singly or in combination
559	Aluminium Silicate	10 g/kg	Calculated as SiO_2 used singly or in combination

APPENDIX III

Technological justification of Additives

1. Colours:

Raw materials for processed cheese change colours in relation to temperature and to region of production. Consumers are used to certain flavours and colours the year round and it may therefore be necessary, at times, to use colours to maintain the visual quality.

A brownish colour might appear as a consequence of the Maillard reaction (brownish colouring due to heating the lactose) despite the fact that only a small amount of lactose is available. If this happens, either a discolouring agent (e.g. chlorophyll and copper chlorophylls which are complementary colours to the naturally occurring carotenes in cow's milk) or a dye to mask the brownish colour may be necessary.

Colours may also be needed when more than one variety of cheese is used in the manufacture of processed cheese and processed cheese preparations. In this case it may desirable to single out one of the varieties, and consequently, the colour of the product has to be adjusted according to the colour of that one variety.

Colours should be restricted as stated in the table above.

Beta-apo-8´- carotenal

Beta-apo-8´-carotenal is a colour used in processed cheese products in combination with beta-carotene (160a) as an alternative to Annatto or combinations of paprika extract and beta-carotene. Annatto, while widely used in natural cheeses is becoming somewhat unpopular in processed cheeses because it is sometimes unstable on heating leading to “pinking” of the final product and may, therefore, be unacceptable.

Commercial preparations of combinations of Beta-apo-8´-carotenal and beta-carotene are available which can be added to give predictable results while paprika extract and beta-carotene are only available as separate colours which have to be added individually or dry mixed prior to addition with the possibility of unpredictability, inconsistency or omission of one or other colour. Simple replacement of Beta-apo-8´-carotenal by paprika extract leads to textural problems, probably due to differences in carriers used.

Finally, Beta-apo-8´-carotenal/beta-carotene is a cheaper alternative than a beta-carotene/paprika extract blend.

2. Emulsifying Salts:

One of the main operations in the manufacture of processed cheese and processed cheese preparations is to form an emulsion of the cheese fat with the aqueous phase in which the protein is found in a colloidal solution. This emulsion is obtained by the use of emulsifying salts/sequestrants.

Emulsifying salts do not act directly as emulsifiers. They increase the emulsifying potential of casein by forming complex soluble salts and soluble alkaline paracaseinate (Na, K) from the casein cations which are available in the cheese as insoluble calcium paracaseinate. Thus the soluble alkaline paracaseinate obtained acts as an emulsifier and forms the emulsion.

The emulsifying salts should meet the following criteria:

- it should strongly bind the bivalent ions in order to promote the combining of the ions with the calcium paracaseinate; this binding allows for a small input of sequestrant;
- it should be water soluble in order to get closer to the micelles of calcium paracaseinate;
- it should not be of high molecular weight in order for the sequestering to be adequately rapid; and
- it should be innocuous from the sensory and physiological angles.
- in processed cheese, one ideal specific emulsifying salt does not exist but blends of phosphates and/or citrates are used to utilise their differing properties.

Phosphate Emulsifying Salts

Orthophosphates:

Sodium orthophosphates have been used, for a long time, in association with the citrates, to produce Processed Cheddar Cheese. They are also used in Europe in mixtures with the polyphosphates, especially because they are excellent pH regulators and buffers.

Polyphosphates:

Although the extremely polymerized and condensed long chain alkaline polyphosphates are the best sequestrants, other secondary reactions exist. However, these secondary reactions have technically as much importance as the major one, which consist of the formation, with the molecule more or less transformed from the casein of the cheese, by the different complex phosphocaseins, according to the emulsifying salts used. They also have physical properties and organoleptic characteristics.

Diphosphates and Triphosphates:

The less condensed polyphosphates, di-phosphates and tri-phosphates, enjoy unique properties, because, while the di-phosphate gives high viscosity to solutions, the tri-phosphate gives greater fluidity, both having great sensation of smoothness of texture in the mouth.

Like the paracaseinate of different cheeses, or the same cheese in different states of maturation, it is transformed into very different complexes. The exclusive use of polyphosphates which are highly polymerized often gives unsuitable viscosities (too high or too low) for the automatic packaging process, and at other times products which have poor texture to taste. Both defects are corrected by adding a certain percentage of di-phosphate or tri-phosphate.

The di-phosphates and tri-phosphates are never used alone due to the fact that, as with what occurs in the orthophosphates, their complex Ca salts are easily hydrolyzed into simple salts, which are insoluble in water, giving rise to gritty, emulsified cheeses, due to the accumulation of small crystals. It is the highly polymerized polyphosphates which, in sequestering the calcium, impede the said formation.

pH and buffering capacity

Another property of di-triposphates and tri-phosphates is their important buffering ability due to their 4 and 5 substitutable hydrogens, much greater than in the case of orthophosphoric acid, which although in theory has 3 substitutable hydrogens, can actually only use 2, as will be explained later. This property is nil for the polyphosphates of high molecular weight derived from phosphoric acid with 1 single substitutable hydrogen.

As described, by the action of alkaline cations, some alkaline phosphocaseinates are formed which possess properties endowed with the ability, like all those of their species, to form strong emulsions. This property is used to emulsify the fat of the cheese in the water, which no longer can be exuded by the external agents as it happens in the non-processed cheeses in which the fat is only contained within molecules of calcium paracaseinate.

For the emulsions to be stable, it is necessary, among other conditions, that their pH is within margins, that in this case turns out to be quite narrow (5.5 - 5.85), and that, for a given product, pH does not vary by more than 0.1 - 0.15 units. The pH of cheeses used as raw material varies between 4.6 and 5.8, the most common values being between 4.9 and 5.5. This means, in the great majority of the cases, it is necessary initially to elevate the pH of the raw material by some tenths of units.

Experience shows that 40 g/kg, expressed as anhydrous substance, should be the maximum level of use. However, within this limit, the added phosphorus compounds should not exceed 20 g/kg, expressed as P_2O_5. These levels coincide with the levels in the present standards A-8 (a) - (c).

3. Acidity Regulators:

For the emulsion to stay stable, the pH, among other requirements, should be within certain limits; such limits are narrow in the case of processed cheese and processed cheese preparations, being in the range of 5.5 to 5.85. The limits are determined by the structure of the final product and its durability. For a given product the pH does not vary by more than ± 0.1 to 0.15 units.

The type and the amount of emulsifying salts used are determined according to the texture and the characteristics of the desired final product. It is attempted to use the emulsifying salts in order to bring the pH to its correct value, but the variation in pH value to be achieved by the emulsifying salts in the mixture of raw materials is determined by the extent of the ripening and of the buffering capacity of the cheese and of other raw materials; it is also determined by the pH and by the buffering capacity of emulsifying salts as well as by the fat level in the product. It is therefore not possible to use a proper selection of emulsifying salts to adjust the pH to the desired value, and acidity regulators are required.

Should the pH not be adjusted within the above mentioned limits, consequences could be:

- with a pH exceeding 5.85: there is a danger of bacterial contamination; the texture becomes excessively soft causing packaging problems
- with a pH below 5.5: the products becomes considerably harder with negative consequences for the consumer. The casein insolubility is increased as soon as its isoelectric point is being attained (pH 4.6), and, in the long run, water drains from the product causing a lower quality of the product and contamination risks.

Glucono delta-lactone (GDL)

GDL is an ester of gluconic acid crystallized by dehydration.

The beneficial effect of its use in processed cheese and processed cheese preparations compared to other acidifiers stems from the fact that it will progressively acidify the cheese due to the slow development of free gluconic acid when dissolved in water and thereby be uniformly distributed in the mix without flocculation of casein.

This fact for instance will allow the product to be packed at a pH corresponding to a suitable texture; in time the pH of the product will decrease slightly thus resulting in a better keeping quality.

ADI-values for the lactate, citrate, carbonate and GDL acidity regulators of interest are not specified and therefore no maximum level should be set. Instead these acidity regulators should be permitted according to good manufacturing practice (GMP).

However, the permitted levels for phosphoric acid and its salts should be fixed at 5 g/kg expressed as P_2O_5. (NOTE: the total amount of added phosphorus compounds, either as emulsifying salt or as acidity regulator, should not exceed 20 g/kg expressed as P_2O_5).

4. Preservatives:

Due to their composition and due to their pH, which is close to 5.7, processed cheeses and processed cheese preparations are on the one hand readily exposed to yeasts and moulds (including those producing aflatoxins) and on the other prone to “blowing” mainly due to *Clostridium tyrobutyricum* from certain types of cheeses.

Specifically to combat the action of such microbial agents, preservatives are required; among these, in view of their efficacy, special mention is given to propionic and sorbic acids and their salts for the prevention of yeasts and moulds, to nisin for the prevention of *Clostridium,* to sodium and calcium ascorbate for the prevention of moulds and to lysozyme hydrochloride in the prevention of spoilage by bacteria, including spores, that survive the processing temperatures.

Propionic acid and its sodium calcium and potassium salts

The range of action of propionic acid and its salts cannot be precisely identified because of their non specific behaviour, but they are especially active against yeasts and moulds, and they are therefore required to hinder the growth of these microorganisms in processed cheese and processed cheese preparations.

The mode of action is not specific. When propionic acid and its salts are available at a fairly high concentration, their inhibiting action is achieved through their accumulation in the cells and through the blocking of the metabolism due to inhibition of enzymes. Bacterial development is also inhibited due to competition with other substances necessary for the growing of the specific microorganism, especially alanine and other amino acids.

Regarding their level of use, 3 g/kg (singly or in combination, expressed as propionic acid) should be adequate to achieve the proper effect. However, since an ADI is not specified, use according to GMP is appropriate.

A level of 3 g/kg is comparable to the amounts of propionic acid found in certain cheeses, for example Emmental, where propionic acid, which is developed in a natural way in the cheese during maturation, may reach levels up to 4 g/kg.

Sorbic acid and its calcium and potassium salts

Sorbic acid and it calcium and potassium salts are authorized in almost all countries in the world for preserving many foods their main action is specifically against yeasts and moulds including those producing aflatoxins.

The most essential anti-microbial effect of sorbic acid is accomplished through the inhibition of some enzymes in the microbial cell. Sorbic acid is also forcibly, although unspecifically, involved in the citric acid cycle as an inhibitor of, inter alia, malate dehydrogenase and isocitrate dehydrogenate. In addition, sorbic acid forms covalent bindings with the -SH enzyme groups, through its own double bonds, thus inactivating the groups. Finally, it is well known that sorbic acid is active against catalase positive microorganisms, since it has an interesting effect on catalase and on peroxidase.

In order for sorbic acid to exert its action on the microbial cell, it should cross the cell wall, and this occurs mainly when the acid is in its undissociated molecular phase. Since the proportion of undissociated sorbic acid is dependent on pH, as appears from the table below, the amount of sorbic acid which needs to be used against a given microorganism, will also be related to the pH value.

The dissociation constant of sorbic acid is 1.73×10^{-5}. Thus the undissociated sorbic acid concentration in relation to the pH is as follows:

pH	*% by weight of undissociated sorbic acid*
7.0	1
6.0	5
5.3	25
5.1	33
4.8	50
4.3	75
3.8	90
3.1	99

According to table 28 of the book by E. Lueck, "Antimicrobial Food Additives", the minimum inhibitory concentration for *Geotriculum candidum* (a common mould in cheese), at pH 4.8 is 1000 ppm. This means (according to the figures given above) that the portion of undissociated sorbic acid, strictly required to achieve a minimum effective function against that mould is 500 ppm.

Thus, at pH 5.3 (processed cheeses are normally close to pH 5.7) a level of at least 2000 ppm would be needed for achieving an undissociated sorbic acid concentration of 500 ppm which would guarantee the inhibiting function of the preservative.

The above fully justifies the statement that, in order to achieve a proper preservative action of sorbic acid and of sorbates in processed cheese and processed cheese preparations an amount of 2000 ppm is required.

In present standards A-8 (a)-(c) sorbic acid and its sodium and potassium salts are permitted at a maximum level of 3000 ppm.

Nisin

Nisin is a polypeptide which functions as a natural antimicrobial, manufactured by the controlled fermentation of *Lactococcus lactis*. Its range of action is not very large; it acts solely against gram positive bacteria, for example, clostridium and other spore formers.

In this respect it could be stated that nisin is complementary to the range of action of sorbic acid, since the latter exhibits its lowest action against said microorganisms.

The development of clostridium spores, more precisely spores of *Clostridium tyrobutyricum*, is one of the potential undesirable problems in the production of processed cheese and processed cheese preparations as spores are responsible for the blowing of processed cheese and processed cheese preparations and for the occurrence of the unpleasant smell making the product unsaleable.

Nisin acts directly against the cytoplasmic membrane and destroys it immediately after spore formation. Active nisin is still available after the heat treatment and is responsible for inhibiting the development of bacterial spores. Nisin does not impinge directly on spores, and its action does not occur during the heating but after.

Nisin is a required additive for inhibiting said bacteria and, according to the literature, the required concentration is 12.5 mg/kg. This coincides with the level authorized in the present standards A-8 (a)-(c).

Sodium and calcium ascorbate

Especially cold packed, individually wrapped processed cheese slices and processed cheese slices without individual packaging need a protection from the growth of moulds.

Ascorbates known as antioxidants reduce the oxygen content in the product. Being more reactive than the food system, the antioxidant is oxidised first, therefore they can be used as a protection against the growth of moulds, as they are aerobic microorganisms which need oxygen for their growth.

Sodium and calcium ascorbate should be permitted according to good manufacturing practice (GMP).

Lysozyme hydrochloride

Lysozyme hydrochloride functions by injuring the cell wall of bacteria and germinating bacterial spores.

Due to the potential for microbiological activity even after heat processing and in consideration of the types of packaging systems used for these types of cheeses (potential anaerobic conditions), the use of lysozyme hydrochloride is functionally justified as a preservative. The re-addition of lysozyme hydrochloride may also be necessary since any lysozyme inherently present in the ingredient cheeses may be partially inactivated by the heating process.

5. Emulsifiers

The use of emulsifiers in processed cheese are needed in order to achieve and maintain a stable oil-in-water emulsion in situations where emulsifying salts are not used and where certain processed cheeses may contain relatively high levels of water and fat. The emulsifiers support the emulsifying ability of the casein, which is obtained by using emulsifying salts. The relevant emulsifiers, lecithins and mono- and di-glycerides of fatty acids, are contained in Table 3 of the GSFA.

6. [Stabilisers]

[While often grouped with thickeners, stabilisers make it possible to maintain a uniform dispersion of two or more immiscible substances in a food.

Although they are safe and suitable additives, their use should be restricted in order to preserve the image of processed cheese. Therefore it should be permitted to use only a limited number of stabilisers in processed cheeses with high moisture or reduced fat content only.

ADI-values for some of the stabilisers of interest for processed cheese are not specified, the exceptions are propylene glycol alginate (INS 405), Diacetyltartaric and Fatty Acid Esters of Glycerol (INS 472e), Sucrose Esters of Fatty Acids (INS 473) and Polyglycerol Esters of Interesterified Ricinoleic Acid (INS 476). For PGA, DFAEG and SEFA, a maximum of 5 g/kg would be appropriate; for PGIRA, a maximum of 10 g/kg would be appropriate; while the other stabilisers listed should be permitted according to good manufacturing practice (GMP).]

7. Anti-Caking Agents

The lack of free flowing properties and, at the most, the caking of divided solids such as may occur with sliced and grated processed cheeses may be due to several reasons:

- pressure

- climatic variations: temperature and relative humidity
- composition and arrangement of particles inherent to each product.

The use of anticaking agents is required and is justified at all steps of the manufacture and handling of sliced and grated products:

(a) Grinding or grating

When this is done, the use of anticaking agents will reduce the length of these operations, resulting in saving man power and energy; the agents will reduce adhesion of the product to the walls and to the parts of the equipment.

(b) Packaging

The additives will promote the flow of the product through the packaging machine, thus reducing packaging time.

(c) Storage

The additives will preserve the physico-chemical characteristics of the final product resulting in the functionality and appearance desired by the consumer.

Microcrystalline cellulose (INS 460i) and powdered cellulose (INS 460ii) are included in GSFA Table 3 and should be permitted at GMP levels.

When considering the additives for sliced and grated natural cheese (Standard A-6), the CCFAC endorsed maximum levels of 10 g/kg for the silicates. The same level should apply to sliced and grated process(ed) cheese products.

Silicon dioxide and silicates

Silicon dioxide, as well as silicates in their various forms, are substances with a high superficial activity; this means that they are prone to combine with water at the surface of the product, thus avoiding the occurrence of bonds between the various parts of the product. They are compounds which are generally extremely fine, and due to their large area they will by coating have a function of dry lubricant or anti-compacting agent on a sliced or granulated product.

Microcrystalline cellulose

Microcrystalline cellulose is a non fibrous form obtained from fibrous cellulose. It is covered by the INS number 460. Microcrystalline cellulose is thus chemically identical to native cellulose, only it physical appearance is different.

Microcrystalline cellulose has a high affinity to the moisture and the fat occurring at the surface of cheese particles and its use is required to prevent caking and improve the flowing of granulated products, and to prevent sliced products from sticking.