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The Use of Vegetable Fats within the 2003 EU Chocolate Regulations

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Introduction

In June 2000, after about 30 years of discussion, the European Parliament published Directive 2000/36/EC relating to cocoa and chocolate products intended for human consumption. This Directive came into force throughout the EU on 3 August, 2003 and harmonized chocolate legislation amongst all the member states. The result was that each member state has had to modify and ratify the legislation within their own countries.

The new legislation made a number of changes to national regulations – in the labeling of chocolate, in the way in which ingredient percentages should be calculated and in permitting the inclusion of vegetable fats (cocoa butter equivalents) in chocolate in all member states. To cover all the changes made would be the subject of a number of papers and so, I propose to only cover the inclusion of vegetable fats in this paper.

Up to this point the use of vegetable fat in chocolate had only been permitted in the national legislation of seven EU countries – United Kingdom, Ireland, Denmark, Sweden, Finland, Austria and Portugal. In many ways, these were historical effects within the EU in that these countries already permitted the use of vegetable fats in chocolate at the time of their entry into the EU and did not change their national legislation thereafter.

It is also interesting to note that five of these countries – Austria, Ireland, Denmark, United Kingdom and Sweden - were in the top ten ranking of countries by per capita chocolate consumption in 2000[1]. This, in itself speaks well for a positive consumer acceptance of chocolate containing vegetable fat

[1] CAOBISCO Secretariat, Brussels, Summer 1999 – quoted in www.candyusa.org/Stats/chocolateworld.shtml

There were, in general, no constraints on the types of vegetable fats that could be used or in the processes used to make them. The new EU Directive changed that by putting constraints on the base oils, on the processes that could be used and on the physico-chemical interactions between cocoa butter and the vegetable fats. I propose to cover the following aspects of the legislation:

- The permitted base oils
- The permitted processing options
- The required physico-chemical characteristics
- Calculation of the vegetable fat content
- Compliance monitoring
- Comparison with North American chocolate regulations

Permitted Base Oils

The Directive firstly says that the vegetable fats that may be used in chocolate must be non-lauric in origin (apart from a derogation that permits the use of coconut oil in chocolate for the manufacture of ice cream and similar frozen products). There is a good reason for limiting the fats to non-lauric in origin. This is because cocoa butter itself is non-lauric. If we were to use a vegetable fat with cocoa butter which is lauric in origin (i.e. from palm kernel oil or coconut oil) then a eutectic would form that would have a seriously adverse effect on the performance, production and functionality of the chocolate. This eutectic formation is not a real issue, however, in ice cream coatings – indeed it can be a benefit – hence the derogation allowing the use of coconut oil in these types of product.

However, the Directive goes beyond simply specifying non-lauric oils by specifying only six oils from which cocoa butter equivalents (CBEs) can be produced:

Illipe, Borneo tallow or Tengkawang	*Shorea* spp.
Palm oil	*Elaeis guineensis*
	Elaeis olifera
Sal	*Shorea robusta*
Shea	*Butyrospermum parkii*
Kokum gurgi	*Garcinia indica*
Mango kernel	*Mangifera indica*

There were a number of reasons why these six oils were selected. They already were the main components of many CBEs produced in Europe. But most importantly, they all contain significant levels of POP, POSt and StOSt, the major triglycerides in cocoa butter.

[POP, POSt and StOSt are the standard abbreviations used for the major triglycerides in cocoa butter. Essentially they indicate that all of these triglycerides contain oleic acid (O) in the central or 2-position of the triglyceride and either palmitic acid (P) or stearic acid (St) in the outside or 1- and 3-positions of the triglyceride.]

This then allows them or fractions produced from them to comply with another aspect of the EU Directive that these fats should be rich in symmetrical monounsaturated triglycerides of the type POP, POSt and StOSt.

There is, however, a significant difference in availability of these oils. Of the six permitted oils, only palm oil is grown in large quantities as a commercial plantation crop. The other oils are essentially forest crops. This means that their availability from year to year can change substantially. The first of these crops to be used in CBEs was illipe, also known as Borneo tallow as it is on the island of Borneo that it is found. The extent of the crop in any given year depends very much on whether the climatic conditions during the summer allows flowering to take place in September to November. Too much or too little rain can have an adverse effect; strong winds at the wrong time can literally blow the flowers off the trees. If there are no flowers, then the tree doesn't fruit and there is then no crop. In addition, it is unusual for a tree to flower two years running. Padley in The Lipid Handbook[2] quotes volumes of about 7000 tonnes in 1980-82, but some years the crop is negligible.

Shea grows again as a forest crop in West Africa and is a somewhat more certain crop than is illipe. Indeed some of the major producers of CBEs have set up extensive supply chains to ensure the availability of shea butter into their factories. In terms of volumes, Padley quotes trading volumes in 1979 of about 35,000 tonnes.

Sal takes us to the Madhya Pradesh and Orissa regions of India. Again the availability is very variable. Padley reports 35,000 tonnes in 1978, although Campbell[3] quotes an average availability of 60-80,000 tonnes with a spread from 170,000 tonnes down to 20,000 tonnes.

Kokum and mango kernel fats, also from India are generally available in much smaller quantities.

It was this uncertainty in availability that led one multinational in particular to develop a process based on enzyme technology to produce the SOS type of triglycerides needed in CBEs from less exotic oils such as sunflower oil and palm oil. However, the new EU regulations specifically prohibit the use of this process as a means of making a cocoa butter equivalent

In looking at the six permitted base oils and, in particular, at their POP, POSt, StOSt contents it is useful to firstly start with cocoa butter itself. There are three main cocoa-producing regions in the world – Malaysia, West Africa and South America – and the cocoa butters from each of these regions differ in their triglyceride compositions.

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[2] F.D. Gunstone, F.B. Padley, J.L Harwood – 'The Lipid Handbook'

[3] I. Campbell – www.britanniafood.com/common/invite_15.htm

Triglyceride compositions (by HPLC) of cocoa butters from three regions[4]

Triglyceride	Malaysian	Nigerian	Brazilian
POP	15.1	16.1	14.4
POSt	40.3	40.1	34.5
StOSt	29.4	26.8	22.6
Total SOS	84.8	83.0	71.5

Although there are differences, particularly in StOSt levels, the total SOS level in cocoa butter is generally above 70%.

If we now look at the six permitted base oils we find a considerable variation, not only in total SOS levels but also in the individual symmetrical monounsaturated triglycerides.

Typical triglyceride compositions of the six permitted base oils

	Palm oil[5]	Illipe[5]	Shea[5]	Sal[6]	Kokum gurgi	Mango kernel[7]
POP	26	7	<1		Tr	
POSt	3	34	6	7-12	6	
StOSt	Tr	45	30	26-44	72	
Total	**29**	**86**	**36**	**33-56**	**78**	**48**

Of the six oils, only illipe and kokum have total SOS levels similar to those in cocoa butter. Each of the other four oils, therefore, needs to undergo further processing to concentrate up the SOS triglycerides. The process that is used for this is fractionation.

Shea, sal and mango kernel are all fractionated once to give a stearine and an oleine. The SOS triglycerides concentrate in the stearine and it is therefore this fraction that is then used in CBEs. Palm oil also contains a significant level of trisaturated triglycerides that crystallize in the stearine and this then undergoes a second fractionation to remove these leaving the SOS triglycerides concentrated in a middle fraction. After fractionation the symmetrical monounsaturated triglyceride contents of the fractions that can then be used in CBEs are shown in the table below.

The fractionation process does, by definition, also produce fractions that are not used in CBEs. Fractionation of palm oil, for example, produces both a harder fraction and a

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[4] Shukla, V.K.S., Schiotz. Nielsen, W and Batsbery, W – Fette Seifen Anstrichmittel, **85**, 7 (1983) 274-278

[5] Jurriens, G – in *Analysis and Characterisation of Oils and Fats and Fat Production,* Vol. 2, Interscience, London, New York, Sydney (1968)

[6] Wong Soon – *Speciality Fats versus Cocoa Butter* (1991)

[7] Errboe, J – Candy and Snack Industry (1981), Vol. 146, No. 9, pages 48-53

softer fraction. The harder fraction has a variety of applications from peanut butter stabilizer to being used as an excellent powdered fat in, for example, dry soup mixes. The softer fraction has a good oxidative stability which makes it a good alternative to hydrogenated oils as a trans-free frying oil. Shea, sal and mango kernel oleines can all be used further in other confectionery applications as component of toffee fats or filling fats.

Typical triglyceride compositions of fats and fractions suitable for use in cocoa butter equivalents

	Cocoa butter	Palm fraction	Shea fraction	Illipe	Sal fraction	Kokum	Mango kernel fraction
POP	16	66	1	7	Tr	Tr	1
POSt	37	12	7	34	10	6	16
StOSt	26	3	74	45	60	72	59
Total	79	81	82	86	70	78	76

The effect of these fractionation processes is to produce fats that can then be used directly in cocoa butter equivalents. However, no single fat or fraction has a composition similar to that of cocoa butter so, in order to produce a CBE it is then necessary to blend these fractions. Palm fraction will contribute POP and some POSt to the blend; illipe will contribute POSt and StOSt to the blend; the remaining fats and fractions contribute mainly StOSt to the blend.

If they are blended in such a way that the POSt-rich and StOSt-rich fats predominate then they will have physical characteristics which in many ways can be considered to be 'better' than those of cocoa butter. Such blends are called 'cocoa butter improvers' and are used especially to give improved hardness and heat resistance to chocolate.

If, however, they are blended so that there is a balance between the three major triglycerides that is closer to that normally found in cocoa butter then we have a cocoa butter equivalent.

Processing Options

A second requirement of the Directive is that the vegetable fats to be used in chocolate "are obtained only by the processes of refining or fractionation or both, which excludes enzymatic modification of the triglyceride structure."

So, hydrogenation is not permitted as a process. This is a very common oil modification process in which the cis unsaturated double bonds within an oil are converted to either saturated single bonds or, more often, to trans unsaturated double bonds. In this way it is possible to produce fats that have a similar melting profile to cocoa butter. However, when blended with cocoa butter the compatibility of the two fats is quite limited. Compatibility of the vegetable fat with cocoa butter is an important part of the overall Directive.

Although hydrogenation is not permitted because it is not listed as an allowed process option, it is interesting that the legislation specifically prohibits the use of enzymatic modification of the triglyceride structure.

Some of the six permitted base oils are forest crops rather than plantation crops and, as such, their year-to-year availability and quality can be subject to considerable variations. This particularly applies to illipe which has been historically an important component of CBEs, and to a lesser extent also applies to shea. Because of the uncertainties surrounding the availabilities of these crops a process was developed, some years ago, whereby SOS triglycerides could be produced from alternative oil sources by a process of enzymatic modification. This is a process which generates, for example, the StOSt triglycerides that are needed for CBEs. It essentially relies on using an enzyme as a catalyst that is position-specific in the sense that it will allow the interchange of fatty acid groups between triglycerides or between a triglyceride and a fatty acid – only at the 1- and 3-positions. Any fatty acids at the 2-position are left completely unchanged. So it is possible to start with an oil containing a high proportion of oleic acid at the 2-position. This can then react with stearic acid in the presence of an enzyme and interchange at the 1- and 3-positions will result in the formation of StOSt. The drawback with this process is not a technical one but possibly a political one in that all the raw materials necessary for the process can be obtained from 'temperate' oils rather than using oils such as shea, sal and illipe from tropical developing countries.

Having described what is not allowed, and why, let us look at what is allowed. Essentially we are left with fractionation and refining. We have already seen that fractionation is an important process in terms of concentrating the total SOS triglycerides in palm, shea, sal and mango kernel oils. Refining is a process used for almost all oils and fats products irrespective of the composition, their base oils or their end use. The three main steps in refining ensure that the fat is firstly free from any remaining fatty acids, secondly free from colour and oxidation products and thirdly free from odours and off-flavours. This can be achieved either in the three separate steps of neutralization, bleaching or deodorization or can also be achieved by using physical refining which removes these unwanted components by means of a high temperature treatment.

Physico-chemical Characteristics

This brings us now to the third constraint defined in the legislation.

The vegetable fats used in chocolate must be miscible in any proportion with cocoa butter, and be compatible with its physical properties (melting point and crystallization temperatures, melting rate, need for tempering phase).

Let's look at the 'need for tempering phase' first. Chocolate needs to be tempered because the cocoa butter which it contains is a polymorphic fat. This means that it can crystallize in a number of different crystal forms. Tempering forces the cocoa butter to crystallize in one of the two most stable crystal forms thereby ensuring that the

chocolate has a good shelf-life and storage stability. It is important that any vegetable fat also used in chocolate does not disrupt this. The reason behind cocoa butter's polymorphism is its simple triglyceride composition with 70% or more of its triglycerides being of the symmetrical monounsaturated type. By ensuring that the base oils used in the CBE part also contain significant levels of these triglycerides we also retain the overall polymorphism of the fat phase and hence the need to temper. As an example, the major triglycerides of cocoa butter and of a traditional CBE are shown in the Table below.

Triglyceride composition of cocoa butter and a CBE

	Cocoa butter	CBE
POP	16	35
POSt	37	15
StOSt	26	33
Total symmetrical TGs	79	83

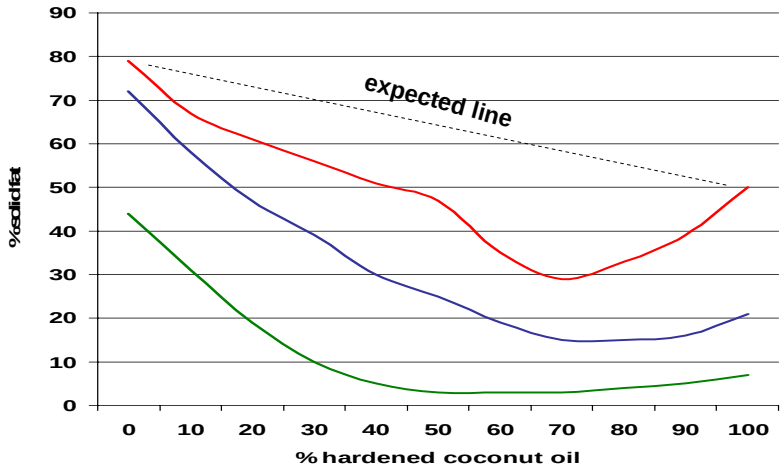
What does the Directive mean by miscible and compatible?

Essentially these relate to the ways in which the triglycerides in cocoa butter and the triglycerides in the vegetable fat interact with each other. To put it simply it relates to whether the vegetable fat forms a eutectic when it is mixed with cocoa butter or whether it doesn't. If you're not sure what a eutectic is then think back to the winter when you might have put salt on to an icy driveway to melt the ice. What is happening is that a eutectic is being formed between the salt and the ice which reduces the freezing point of the water so the ice melts. This can also happen when two fats or even two triglycerides are blended with each other. In some instances a eutectic composition can be formed in which the melting point or solid fat content of the blend is below that of the individual components. It is this effect that the Directive is keen to prevent by ensuring that the vegetable fats used in chocolate do not form a eutectic with cocoa butter and therefore unduly soften the chocolate.

It is relatively easy to demonstrate eutectic formation by means of a binary phase diagram. Binary phase diagrams can take a number of forms and be constructed from a variety of data but one of the simplest is one based on binary blends showing the solid fat contents at different temperatures. The best way then of demonstrating compatibility and miscibility is to look at two extremes.

At one extreme there is the binary phase diagram of the NMR solid fat contents of cocoa butter and hardened coconut oil.

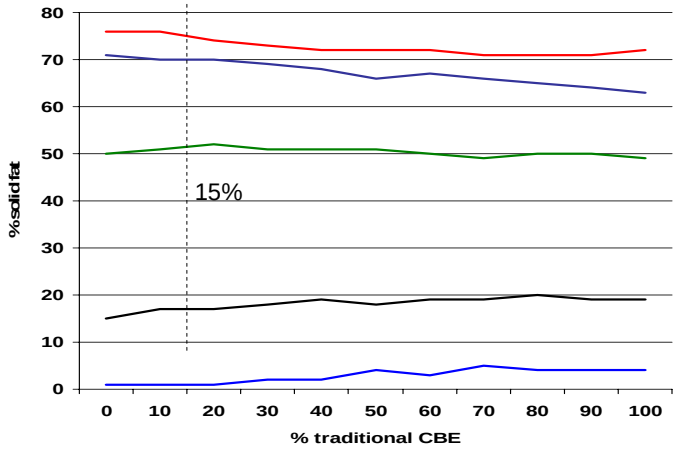
NMR binary :
Cocoa butter / Hardened coconut oil



If cocoa butter and hardened coconut oil are blended together, then the solid fat content decreases as the hardened coconut oil content increases. But then, at a certain point – at about 75% hardened coconut oil – the solid fat content starts to increase again. This is a good example of a eutectic composition. If the two fats had a good compatibility with each other then we would have expected to have seen more of a straight line change moving from one end of the diagram to the other. So, this type of system would not be permitted under the EU Directive because of its lack of compatibility and miscibility. It would also, of course, not be permitted because hydrogenation is not allowed and because coconut oil is also not permitted (except in chocolate for ice cream).

On the other hand, an example of very good compatibility between cocoa butter and a vegetable fat is shown when a traditional cocoa butter equivalent is blended with cocoa butter.

NMR binary
Cocoa butter / traditional CBE



The difference is immediately apparent. In this case the lines joining 100% cocoa butter and 100% CBE are straight. This means that there is no eutectic composition and shows that cocoa butter and the traditional CBE are fully compatible over the complete range of compositions.

This is important because the Directive says that the fats must be miscible and compatible in any proportions and not just in the proportions that would be equivalent to a 5% usage level in chocolate. No lowering of solid fat content at any temperature is detected as one fat is added to the other. In addition, there is no indication of separate phases unique to one or other component.

Calculation of fat content

This brings us then to how the fat content is calculated. The Directive permits the use of up to 5% vegetable fat (meeting all the constraints we have already discussed) in chocolate. But 5% of what?

The legislation permits the use of 'other edible substances' in chocolate but the vegetable fat cannot be regarded as one of these 'other edible substances'. It is allowed to be used in a proportion of up to 5% of the chocolate portion of a product. So, for example[8] we will take a milk chocolate bar containing nuts with the following composition:

[8] UK Food Standards Agency Guidance Notes, 1 August 2003

Sugar	36
Milk solids	18
Cocoa solids	22
Vegetable fat	4
Nuts	18
Lecithin	1
Vanillin	1

The vegetable fat can only be calculated on the ingredients above the line, the chocolate portion of the composition. So, in this example the vegetable fat content would be 4g/80g or 5% - even though it is in reality only 4% of the end product. Calculating the total fat content is even more confusing. The Directive defines a minimum fat content in chocolate of 25% but the vegetable fat cannot be counted as part of this. Taking again the above chocolate composition but this time breaking out the fat parts of the cocoa and milk solids we find:

Sugar		36
Milk solids		18
- of which milk fat	4.8	
Cocoa solids		22
- of which cocoa butter	16	
Vegetable fat		4
Nuts		18
Lecithin		1
Vanillin		1

The total fat content is calculated to be the cocoa butter + milk fat expressed as a percentage of the chocolate portion of the composition, i.e.:

$$\frac{16g + 4.8g}{80g} = 26\%$$

Compliance monitoring

Now, just a word or two about compliance monitoring. No specific procedure has been put in place by the EU for compliance monitoring. This has been left to the procedures and structures that are already in place in each member state. So, for example, in the UK we have Trading Standards Officers who are able to go into factories, at no notice, to ensure that everything is being produced according to the law. In the UK, therefore, they will be able to take samples of ingredients and finished products for analysis and check through documentation to satisfy themselves that the chocolate is being made according to the regulations. There will be a similar procedure in many other EU countries. For example, in The Netherlands, the “keurings dienst van waren” (or Dutch Tradings Standards Officers) will audit producing companies by taking samples of ingredients and by auditing their financial buying documentation and recipe documentation. In this way, they will be able to see if producers are working inside or outside the law.

There are analytical methods available to analyse the chocolate to determine whether vegetable fats are present and, if very sophisticated methods are used (e.g. sterol analysis) to then define what the origins of these fats are.

Comparison with USA, Canadian and Mexican Regulations

Finally, how does the EU Directive compare with those regulations in place in Canada, the USA and Mexico and with the Codex Alimentarius standard?

In Canada, chocolate is defined as a combination of either cocoa liquor, or cocoa liquor and cocoa butter, or cocoa butter and cocoa powder combined with a sweetening agent. The use of vegetable fat other than cocoa butter in chocolate is not therefore permitted. There is, however, the scope for using vegetable fats in a compound coating where the terms 'chocolate-flavoured', 'chocolate-like' and 'chocolaty' have been accepted as appropriate descriptions. There is then no limit on the percentage of vegetable fat used in such products.

In the USA, there is a distinction made between 'chocolate' of various kinds which cannot contain any vegetable fats other than cocoa butter, and 'chocolate and vegetable fat coating' which may contain vegetable fats other than cocoa butter. The latter group containing vegetable fat encompasses 'sweet cocoa and vegetable fat coatings', 'sweet chocolate and vegetable fat coatings' and 'milk chocolate and vegetable fat coatings'. In each case, apart from complying with various minimum levels of cocoa solids and milk solids there are no limits on the amount of vegetable fat that can be used. There is also a wide scope for using a range of vegetable oils, the only specification being that they are 'safe and suitable vegetable derived fats, oils and stearins other than cacao fat. The fats, oils and stearins may be hydrogenated'.

In Mexico, most types of chocolate other than chocolate powder permit the use of up to 5% vegetable fat whilst still retaining the right to call the product 'chocolate'. However, there is a footnote in the Mexican regulations that says that the vegetable fat may not exceed 5% of the total fats in the end product and that the minimum cocoa solids must be maintained. Since most chocolate contains around 30% fat, this would indicate that the maximum level of vegetable fat other than cocoa butter permitted in the end chocolate would effectively be around 1.5%.

Although there are discussions taking place about the Codex standard, in its current form it dates back to 1981. In the current Codex standard (87-1981) there is no allowance for the incorporation of vegetable fats. However, the Codex Committee have agreed a new draft standard for chocolate and chocolate products which will permit the use of vegetable fats[9]. The addition of vegetable fats should not exceed 5% of the finished product, after deduction of the total weight of any other edible foodstuffs, without reducing the minimum weight of cocoa materials. The Delegations from Canada

[9] Report on the 19th Session of the Codex Committee on Cocoa Products and Chocolate, Fribourg, Switzerland, 3-5 October 2001 (Alinorm 03/14)

and the USA indicated that, whilst their national legislation did not, at present, allow the use of vegetable fats other than cocoa butter in chocolate, they could support the proposal in the interest of international trade.

Each of the various sets of legislation covers a range of different chocolates and to compare them all for each chocolate would be quite laborious so to make a simple comparison between them I have chosen milk chocolate as the comparison point.

Comparison of national regulations and standards for milk chocolate

Ingredient	EU[10]		USA[11]	Canada [12] (D)	Mexico[13]	Codex[14] STAN 87-1981
	Milk chocolate	Family milk chocolate				
Cocoa butter				≥15%	≥20%	
Fat-free cocoa solids	≥2.5%	≥2.5%		≥2.5%	≥2.5%	≥2.5%
Total cocoa solids	≥25%	≥20%	≥10%(C)	≥25%	≥25%	≥25%
Milk fat	≥3.5%	≥5%	≥3.39%	≥3.39%	≥2.5%	≥3.5%
Fat-free milk solids						≥10.5%
Dry milk solids	≥14%	≥20%	≥12%	≥12%	≥14.0%	
Total cocoa and milk solids					≥40%	
Total fat	≥25%(A)	≥25%(A)				≥25%
Sugars						≤55%
Vegetable fat	≤5%(B)	≤5%(B)	Not permitted	Not permitted	≤5%(E)	Not permitted

A. cocoa butter and milk fat
B. calculated as a percentage of cocoa solids, milk solids, sugars and vegetable fat
C. chocolate liquor calculated by subtracting from the weight of the chocolate liquor used the weight of cocoa fat therein and multiplying the remeainder by 2.2, dividing the result by the weight of the finished milk chocolatre and multiplying the quotient by 100
D. milk chocolate in Canada may also contain up to 5% whey or whey products
E. the Mexican regulations have a footnote saying that the vegetable fat must not exceed 5% of the total fat in the product, so the actual level in the chocolate will be much less than 5%

There are a number of differences between each of these chocolates. The EU has defined two types of milk chocolate – one with a total cocoa solids of greater than 25% and total milk solids of greater than 14%, the other with lower cocoa solids and higher milk solids. The first one conforms to what a large part of Europe considers to be milk chocolate; the second is the type of milk chocolate more traditionally found in the UK

[10] Directive 2000/36/EC of the European Parliament and of the Council of 23 June 2000
[11] Title 21 of the US Code of Federal Regulations (21 CFR) Part 163
[12] Division 4 of the Canadian Food and Drug regulations
[13] NORMA Oficial Mexicana NOM-186-SSA1/SCFI-2002
[14] Codex Standard STAN 87-1981

and Ireland. The term ' family milk chocolate' will be used in most of the EU countries but, because this type of chocolate is traditional in the UK, it will not have to be used on labels in that country.

Summary

It has taken about thirty years for the EU to come to an agreement about the use of vegetable fats in chocolate so it is difficult to explain and summarise all the ins and outs of this in just twenty minutes but I hope that you have got at least an indication of what is happening on the other side of the Atlantic, the constraints that have been imposed and how the EU legislation differs from those in countries on this side of the ocean.

Bibliography

- G. Talbot – 'Vegetable Fats' published in 'Industrial Chocolate Manufacture and Use', 3rd Edition, chapter 17, ed. S.T. Beckett – Blackwell Science, Oxford, 1999

- Wong Soon – Speciality Fats versus Cocoa Butter (1991)
- G. Talbot - 'A New Generation of Cocoa Butter Equivalents' - Confectionery Manufacture and Marketing, 1991
- Facts About Fats No. 3 – 'Fat Systems in Chocolate' – published by Loders Croklaan (see also http://www.croklaan.com)
- Legislation:
    - EC Directive 2000/36/EC – Cocoa and Chocolate Products for Human Consumption, 23 June 2000 (http://europa.eu.int/scadplus/leg/en/lvb/121122b.htm)
    - UK Cocoa and Chocolate Products Regulations 2003 – Guidance Notes issued by the Food Standards Agency, 2 August 2002
    - US Title 21 of the Code of Federal Regulations Part 163 (http://www.access.gpo.gov/nara/cfr/waisidx_03/21cfr163_03.html)
    - Canada Division 4 of the Food and Drug Regulations (http://laws.justice.gc.ca./en/F-27/C.R.C.-c.870/123956.html#rid-124057)
    - Mexico NORMA Oficial Mexicana NOM-186-SSA1/SCFI-2002, Productos y servicios. Cacao, productos y derivados. I Cacao. II Chocolate. III Derivados. (http://www.salud.gob.mx/unidades/cdi/nom/186ssa12.html)