TRACKING DOWN THE CHOCOLATE ADULTERATION BY REPLACING THE COCOA BUTTER

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Abstract
This paper presents two procedures of tracking down the adulteration of chocolate by replacing the cocoa butter, using as substitution fat, cow butter and palm tree solid fat.
The adulteration of chocolate and other chocolate products can be realised through adding starchy substances, dextrin, galantine, but mostly through replacing the cocoa butter fat with fat substitution substances.
The cocoa butter is a natural ingredient, extracted from cocoa beans. It contains the oleic acid's glicerides, stearic's , palmitic's and linoleic's.
The cocoa butter composition next to the surrogate's is presented in table 1, from wich we can see the composition's homogeneity in fat acids. Over 90% of fat acids are long chain acids: stearic, palmitic, oleic in almost equal proportions. The cocoa butter triglicerides structure is presented in the second table.
The cocoa butter can be replaced (partial or total) with: cocoa butter equivalents (CBE's), cocoa butter replacers (CBR's) and cocoa butter substitutes (CBS's).
The fat which replace the cocoa butter is obtained from natural oils with high fat acids C_{16} and C_{18} content through hydrogenation. Having the same quality composition with the cocoa butter, it mixes well with it in the chocolate products, especially as cocoa powder rich in cocoa butter or as cocoa table.
The fat which substitutes the cocoa butter have a totally different trigliceride composition of the cocoa butter. They are also called laurice fat, due to its high content in lauric acid and are obtained from natural fats through hydrogenation and fractioning. Because of the big composition differences they are not temperable with the cocoa butter.
Next to determing the total fat substances content, the presence of other fats must be checked, mostly the solid vegetable fats or set through hydrogenation being used. The presence of faked vegetable set fats with solid fats is established by the iodine coefficient determination of the extracted fat which must have its value over 40 at the normal chocolate and its saponification coefficient that must be smaller than 190 at the unfacked chocolate.

Keywords: Iodine coefficient, Saponification coefficient, fat substitution, *triglyceride composition, cocoa butter*

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1. INTRODUCTION

The food adulteration, including drinks, totalises the illicit processes which suposes:

- The total or partial substitution of one or more components of the raw material;
- The addition of natural or synthetic substances which determines the chemical composition and sensory prepertyes modification, with the replacement purpose of some valuable components with some cheaper ones and obtaining undeserved benefits;
- The addition of natural or synthetic substances concerning the covering of some deffects or giving unjustified propertyes of the raw material;
- The use of some ingredients and unallowed alimentary additives or the use of bigger doses than the recomanded ones;
- The commercialization of an imitation product (surrogate) instead of the original one (Mitchell J).

Briefly, it could be said that the adulteration stands in a unauthorised ticketing or in products' counterfeit, with the purpose of selling a cheap product as a expensive one with obtaining some undeserved capitals (Ashunt and Dennis, 1996; Bratu, 2005).
The adulteration of chocolate and other chocolate products can be realised through adding starchy substances, dextrin, galantine,

but mostly through replacing the cocoa butter fat with fat substitution substances (Bulancea, 2002).

Table 1 The content in fat acids of different fats used in the chocolate industry.

Fat acid	Cocoa Butter	Cocoa butter equivalents	Cocoa butter replacers	Cocoa butter substitutes
C_8	-	-	-	3
C_{10}	-	-	-	3
C_{12}	-	-	-	54
C_{14}	-	-	-	20
C_{16}	25	30	12	9
C_{18}	36	30	14	10
$C_{18.1}$	34	35	67	-
$C_{18.2}$	3	3	6	-
C_{20}	1	1	-	-
Other fat acids	1	1	1	1

[9, 10]

Table 2. Cocoa butter's composition in triglicerides

Cocoa butter's composition in triglicerides		The triglyceride composition considering the total number of carbon atoms	
Trigliceride	The per cent content	The carbon atoms number	The per cent content
POSt	36,3-41,2	C_{50}	18
StOSt	23,7-28,8	C_{52}	49
POP	13,8-18,4	C_{54}	32
StOO	2,7-6,0	C_{56}	0,4
StLiP	2,4-6,0		
PliSt	2,4-4,3		
POO	1,9-5,5		
StOA	1,6-2,9		
PliP	1,5-2,5		
StLiSt	1,2-2,1		
OOA	0,8-1,8		
PPSt	8,0		
PStSt	0,2-1,5		
POLi	0,2-1,1		
OOO	0,2-0,9		

Legend: A – arahidonic acid; Li – linoleic acid; O – oleic acid; St – stearic acid; P – palmitic acid.

The cocoa butter is a natural ingredient, extracted from cocoa beans. It contains the oleic acid's glicerides, stearic's , palmitic's and linoleic's; it is a great emollient, it purifies the skin, nourishes the tisues, it is a natural factor protection UV, it regenerates the skin, detains ageing, it silkens and improves skin elasticity, it makes the skin smooth, supple, silky, delicate, with a healthy aspect.

The cocoa butter composition next to the surrogate's is presented in table 1, from wich we can see the composition's homogeneity in fat acids. Over 90% of fat acids are long chain acids: stearic, palmitic, oleic in almost equal proportions. The cocoa butter triglicerides structure is presented in the second table 2.

The cocoa butter can be replaced (partial or total) with: cocoa butter equivalents (CBE's), cocoa butter replacers (CBR's) and cocoa butter substitutes (CBS's).

- CBE (cocoa butter equivalents) is a partial replacer (in the ratio of 5%) of the cacao butter obtained through the carefully choosed of the raw meterial so that the chemical composition should be similar with the cocoa butter's one. CBE's are perfect compatible with the cocoa butter. Most CBE's used as partial replacers of the cocoa butter must compensate for:
  - Freshness due to a considerable quantity of fat introduced by including the cream powder in the chocolate recepy;
  - Freshness due to using a softer cocoa butter;
  - Freshness due to the sorage/usage in a warmer climate.

In this cathegory are part CHOCOMATE 3200 si CHOCOMATE 3100, products which have a perfect compatibily with the cocoa butter's one (Beckett, 1998).

CBR (cocoa butter replacers) replaces the cocoa butter in ratio of 10-15% leading to the obtaining of a chocolate with stronger chocolate flavour by adding the chocolate liquer in different recipes. Thanks to the fact that the products wich contain CBR only needs a light burning, the recension program will be less complicated, will take less time, finally leading to lowing the bugets and a smaller price and obviously more competitive. In this cathegory are part HISOMAT si HISOMEL.

- CBS (cocoa butter substitutes) totally replaces the cocoa butter. Using CBS as substitution fat, we shall obtain a chocolate with a greate shine, a crispy richness and a fast melting, leaving a cooling sensation in mouth.

The chocolate and pastry based on CBS do not need burning not staying a long time to hill.
The fat which replaces the cocoa butter is obtained from natural oils with high fat acids C_{16} and C_{18} content through hydrogenation. Having the same quality composition with the cocoa butter, it mixes well with it in the chocolate products, especially as cocoa powder rich in cocoa butter or as cocoa table.
The fat which substitutes the cocoa butter have a totally different trigliceride composition of the cocoa butter. They are also called laurice fat, due to its high content in lauric acid and are obtained from natural fats through hydrogenation and fractioning. Because of the big composition differences they are not temperable with the cocoa butter.
Next to determing the total fat substances content, the presence of other fats must be checked, mostly the solid vegetable fats or set through hydrogenation being used (Beckett, 2000; Emmanuel, 2010).
The presence of faked vegetable set fats with solid fats is established by the iodine coefficient determination of the extracted fat which must have its value over 40 at the normal chocolate and its saponification coefficient that must be smaller than 190 at the unfacked chocolate.
The cocoa butter is a fat with a rich composition that offers it great properties. At the room's temperature it is solid and fresh, giving this property to chocolate. It melts at 32^0C , reason why in the moderation process the optimum temperature is 32-34^0C, where the cocoa butter's B form is jelling, the stabile form which gives chocolate lubricity and prevents whitening in time (Beckett, 2000).

2. MATERIALS AND METHODES

In the applied determination it was used as control samples the Poiana and Milka chocolate.
As fake samples it was realised in the microproduction laboratory two chocolate samples: P_1, using as substitution fat the cow fat; P_2 using as substitution fat the palm tree oil according to a production recipe based on the material balance.
As fat extraction process from the assays it was used the chill extraction method with petroleum ether; from the extracted fat it was determined the iodine coefficient with the Hanus method and the saponification one with the standard method (Bratu, 2005).

3. RESULTS AND DISCUSSION

After the determinations on the chocolate assays were made, it was obtained the next results presented in table 3:

Table 3 The iodine and saponification coefficient

Sample	Iodine coefficient	Saponification coefficient
Control sample Poiana	41,01	180,3
Control sample Milka	42,1	183,5
P_1	29,89	252,2
P_2	21,73	240,7

It can notice that the samples P1 and P2 have the iodine coefficient under 40 which indicates the chocolate adulteration with other fats, and the saponification coefficient goes beyond 190 which leads again to the conclusion that the samples P1 and P2 are fake samples (fig.1 and fig.2).

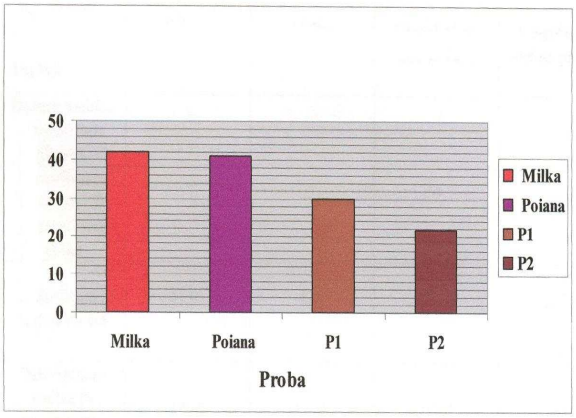

Fig. 1.- The value of iodine coefficient

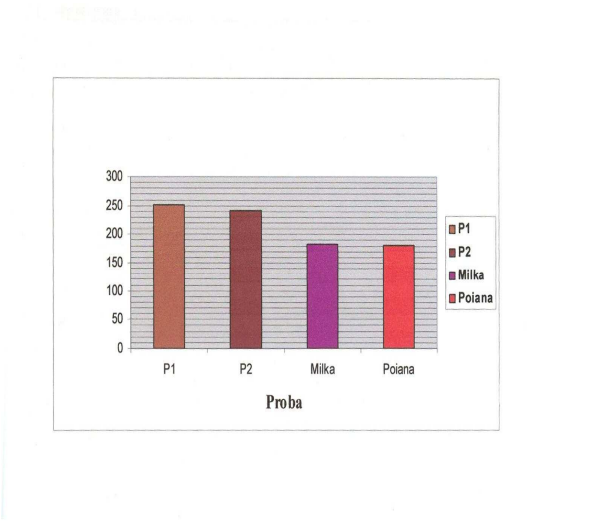

Fig.2. The value of saponification coefficient

It can notice at the control samples Poiana and Milka that the iodine coefficient has bigger values than 40 and that the saponification coefficiet is smaller than 190, which denotes that theese samples are not adulterated.

4. CONCLUSIONS

The chocolate adulteration, the fake statements regarding their content, the frauds made in the chocolate industry lead to puting in danger the comsumer's health.

An adulterated product leads to prejudices (financial damage) to the consumer who is expecting a higher quality level from a great brand product.

The adulteration with solidified vegetable fats and solid fats can be established by determing the iodine coefficient on the extracted fat which must have its value over 40 at the normal chocolate and the saponification coefficient which must be smaller than 190 at the real chocolate(Bulancea, 2003).

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