THE EFFECT OF USING LECITHIN ON THE TEXTURAL AND RHEOLOGICAL PROPERTIES OF ARTISANAL CHOCOLATE

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Abstract

The main objective of current research is to evaluate the influence of lecithin as an emulsifer on the textural properties of artisanal chocolate. With its origins as a cacoa drink in antiquity, chocolate has evolved throughout history, culminating in a wide variety of chocolate types, including both industrially produced and artisanal varieties. In this context, the role of lecithin in altering the density, viscosity, and texture of chocolate was analyzed. Two chocolate samples were prepared, one containing lecithin as an emulsifier and a control sample. These samples were subjected to analysis to evaluate density, viscosity with the EVO Expert R digital viscometer, SPAIN and texture using a Mark 10 texturometer, USA. Following studies carried out, the results showed that the chocolate sample with lecithin exhibited a softer texture, making it easier to compress and manipulate in fracture section. Additionally, it also showed lower viscosity compared to the control smaple.

Key words: artisanal chocolate, density, viscosity, texture, lecithin

Chocolate is a suspension composed mainly of solid particles of cocoa, sugar, milk and cocoa butter, which at temperatures above 36°C behave as a Newtonian fluid (Afoskwa E., 2010).

Each individual ingredient has an important role in the chocolate manufacturing technology, therefore a series of factors that appear during the manufacturing process, as well as after its completion, must be followed.

Currently, chocolate is one of the most appreciated confectionery products in the world, being an important source of polyphenols. According to data from the National Institute of Statistics, there is an increase in chocolate consumption in Romania, so that in 2016 the average monthly consumption per person was 157g of chocolate, while in 2022 a person consumed an average of 206g of chocolate (roaliment.ro).

Lecithin is extracted from soya beans. It is a natural emulsifier that has been used in the food industry, including chocolate production, since the 1930s, as it helps modify the flow properties of chocolate mass. Due to their special molecular structure, these surface-active ingredients reduce the surface tension between the dispersed and continuous phases (Minife B.W., 1980).

Emulsifiers help mix two or more liquids that don't naturally mix. Soy lecithin is added to chocolate to prevent the ingredients from separating so that the final product has a uniform consistency and can be molded and shaped into an ideal shape, as well as to achieve a smooth texture (Elevina S., 2015).

Also, soy lecithin is added to chocolate to obtain the maximum benefit of reducing viscosity and yield value in a ratio of 0.5-0.7%, this ratio is made according to the fat content, the content of moisture and particle size distribution. At higher levels than these, depending on the other ingredients used, lecithin can have the opposite effect *on the yield value* (Ferenc A.M., 2017).

The amount of lecithin needed to optimise rheology increases as the fineness (particle size) of the chocolate decreases. Thus, the ability of lecithin to influence rheological properties decreases as the fat content of the chocolate increases. Lecithin can bind particularly strongly to sugar, and this makes it very effective in chocolate making. (Beckett S.T., 2000).

The main objective of the research is to evaluate the impact of the use of lecithin addition on textural and rheological parameters by making two samples of chocolate, a control sample and a sample with lecithin as emulsifier.

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MATERIAL AND METHOD

The research was carried out at the "*Ion Ionescu de la Brad"* University of Life Sciences in Iași, in the laboratory "Unitary Operations for the Food Industry", and the two chocolate samples were made in the pastry processing workshop, located in building Technology of food products processing.

A technological flow was established for the production of the two samples of artisanal chocolate that includes each step, the only difference between the two products being the use of lecithin addition for the experimental sample.

The technological flow starts with the boiling of water with added sugar to form a thick and sticky syrup by dissolving sugar in water at a temperature of 110-115ºC. To avoid the formation of sugar crystals during this boiling process, mixing of the two ingredients should be avoided until the composition starts to boil. Then the butter is melted into the resulting syrup.

The homogenization operation consists in bringing all the ingredients into contact. Thus, over the syrup made of water and sugar, the butter is added, after which the solid substances (cocoa, milk powder) are added, and the temperature that must be recorded during the process is 40-50ºC. It is important not to exceed this temperature range to avoid the deterioration of the flavor and the loss of the chocolate's nutritional properties.

The molding operation is done in the form of bars in cylindrical plastic matrices with a diameter of 10 mm and a height of 12 mm. The operation of cooling the cast mass consists in the solidification of the mass and the formation of the structure. The specific cooling temperature is between 2-3ºC, since at a temperature higher than 10ºC "fatty bleaching" occurs. During the demoulding operation, the temperature of the room must be between 15-18ºC, the relative humidity of the air must be between 65-70ºC, and the temperature of the chocolate must be between 12-15ºC in the moment of removal from the form.

After making the two samples, the following determinations were made to see the influence of lecithin: density (g/cm³), viscosity (cP) with the digital viscometer EVO Expert R, Spain, texture with the texturometer Mark 10, USA.

To determine the density, the chocolate was melted and transferred into a cylinder, thus the mass of the sample was determined by weighing on a balance. The density formula (ρ=m/v) was applied.

The viscosity of the melted chocolate samples was determined in the case of the control sample, at temperatures between 30-65ºC, and as for the lecithin sample, the temperatures were between 30-55ºC. The samples were prepared and tested with the Digital EVO viscometer, with the probe corresponding to the type of food, namely cylindrical pin type R7.

Regarding the texture determination, 4 types of probes were used, which were attached to the MARK 10 texturometer *(table 1).* The chocolate samples were prepared according to the probe type, thus the samples were bar type, 2.5 cm cube type L, l, h.

Table 1

Mark 10 Texturometer Probes

Warner Bratzler knife	Cone type probe	Cylinder type probe	Bend type probe
			

RESULTS AND DISCUSSIONS

Regarding the determination of the density of the two chocolate samples, a difference can be observed between the two results in *table 2*, so that for the control sample a lower result was obtained compared to the result obtained by the lecithin sample, the result closer to the value the reference being that of the sample with lecithin, an aspect determined by the presence of lecithin as an emulsifier that slightly increases the density of chocolate.

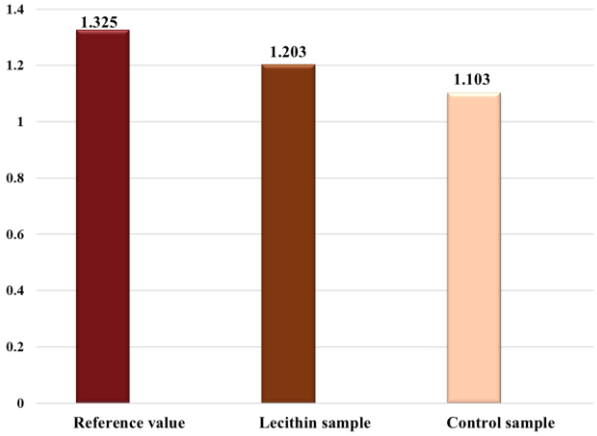

Figure 1 **Results on density, g/cm³**

Figures 1 and *2* show the viscosity curves as a function of temperature, thus comparing the two figures it can be seen that the addition of lecithin caused a decrease in viscosity, the viscosity curve being in a more pronounced decrease in the lectin sample, suggesting that the incorporation of 5 g of lecithin into the recipe of the lecithin sample resulted in a decrease in viscosity. Lecithin is considered an emulsifier that reduces the cohesive forces between cocoa solids and fat particles.

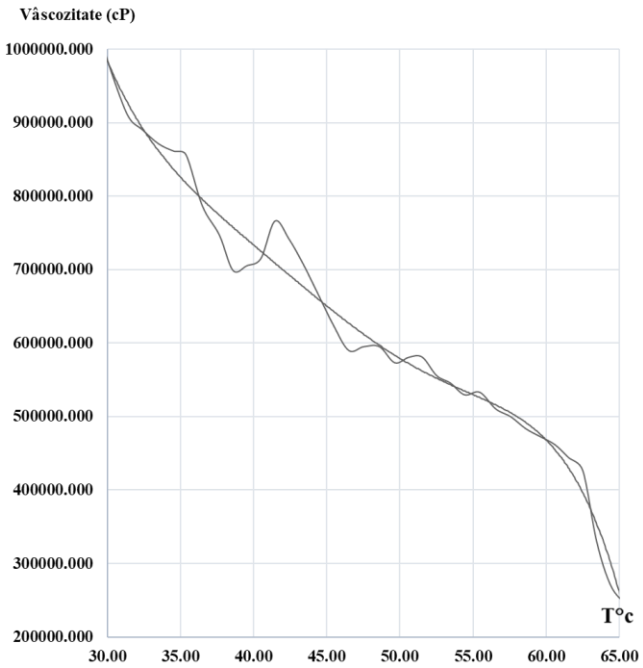

Figure 2 **Viscosity variation with temperature for the lecithin sample**

In order to highlight the influence of lecithin on the texture of chocolate, texture parameters obtained by four methods were analysed: compressive stress with a cylinder-type probe, shear stress with a knife-type probe, compressive stress with a cone-type probe, bending breaking stress. Of the four methods, the most representative were the methods of compressive stress with a cylinder-type probe and bending breaking stress.

By the method of compressive stressing with a cylinder probe the following texture parameters were obtained: cohesivity [-], elasticity [-], resilience [-], gumminess [N], chewability [N]. The results obtained for each parameter show that lecithin had a beneficial effect on them (*figure 3*).

Analysing the cohesivity, the lowest value was obtained in the lecithin sample (0.112) and the highest value was obtained in the control sample (0.397), which means that the lecithin sample showed a softer texture than the control sample, so it is also more crumbly, the value being closer to 0 in this case.

As far as elasticity is concerned, it is observed that the values are very close, so it can be said that both samples fall into the category of plastic products, the values being close to 0.

For resilience, values below 1 were obtained for both samples, suggesting that upon compression the samples could not recover to their original shape.

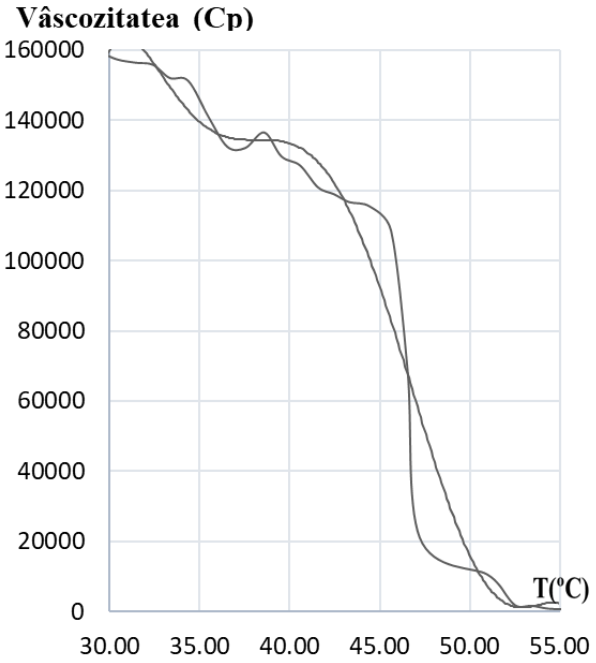

Figure 3 **Variation of viscosity with temperature for the control sample**

The gumminess evaluation showed a higher compressive force for the control sample and a lower force for the lecithin sample.

The results obtained for chewability were defined as 1.379 N for the lecithin sample and 3.257 N for the control sample, it can be stated that the lecithin sample has a lower chewability compared to the control sample.

In order to analyse which type of chocolate breaks more easily, the bending stress method was used. According to the values in *table 3*, it can be seen that lower values were obtained for the sample with lecithin and higher values in terms of the maximum force required for bending in the control sample, a fact due to the presence of lecithin which makes the chocolate softer and more easy to handle when broken into sections.

Table 3

Bending breaking request

Maximum force required [N]	**Control sample**	**Lecithin sample**
	81.4	55.2

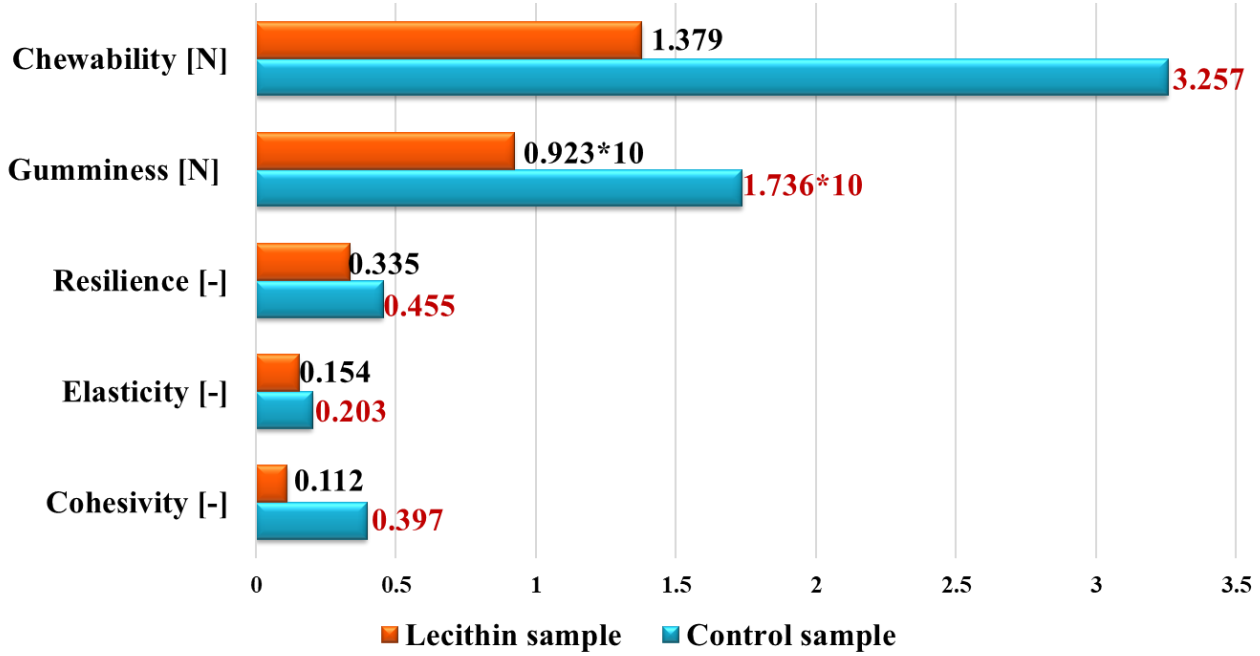

Figure 4 **Compression demand with a cylinder type probe**

CONCLUSIONS

Lecithin has a an important role both in the manufacturing process and on physical parameters such as viscosity, density and texture.

In order to obtain a product with a specific viscosity it is necessary to add lecithin to the composition of the chocolate, since according to the curves obtained the lecithin sample obtained an ideal curve in terms of viscosity.

Analysing the data and comparing them shows that lecithin played an important role in terms of texture, so lecithin chocolate had a smoother and more uniform texture. In terms of the textural parameter of chewability lecithin chocolate is easier to chew, being softer and having a finer texture.

Also in terms of the cutting process of the two samples, the lecithin sample recorded lower values, indicating that the addition of lecithin to the chocolate facilitates the cutting process both analytically (using instruments) and by mastication in the first phase.

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