HYGROSCOPIC PROPRIETIES OF OLEAGINOUS CATTLE CAKES

PROPRIETATILE HIGROSCOPICE ALE TURTELOR OLEAGINOASE

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Abstract: *From the research made on the hygroscopic proprieties of cattle cakes we can say that these absorb vapors from the surrounding atmosphere and the quantity of absorbed vapors is bigger if the relative air humidity is bigger.*
The oleaginous cattle cakes not only have the ability to absorb water but they can also give it away when surrounding atmosphere humidity goes down. It was shown that at the hydrating and dehydrating process of the cattle cakes in an environment with different relative humidity the balance values of the water content do not coincide - the hysteresis phenomenon. It was shown that cattle cakes with the water content above 11 – 13% kept a longer period of time at relative air humidity above 71% had fungus growth.

Rezumat: *Din cercetarile facute asupra proprietatilor higroscopice ale turtelor de floarea soarelui rezulta ca acestea absorb vaporii de apa din atmosfera inconjuratoare, in masura cu atat mai mare cu cat umiditatea relativa a aerului este mai ridicata. Turtele oleaginoase au nu numai proprietatea de a absorbi apa, dar si de a o ceda in cazul cand umiditatea atmosferei inconjuratoare se micsoreaza.S-a aratat ca la hidratarea si deshidratarea turtelor in medii cu diferite umiditati relative, valorile de echilibru ale continutului de apa nu coincid, adica se observa fenomenul de histerezis.S-a aratat ca la turtele cu un continut de apa peste 11-13%, pastrate un timp mai indelungat la o umiditate relativa a aerului de peste 71% - se dezvolta o ciuperca.*

Key words: *humidity, cattle cakes*
Cuvinte cheie: *umiditate, turte de floarea soarelui*

INTRODUCTION

The hygroscopic proprieties of the cattle cakes obtained from the fabrication of vegetable oils from different seeds of oleaginous crops are not well known and this burdens their keeping and evidence. Many cases of ignition of the cattle cakes are known that happened at the snail pressing machines during storage and also during transport in railroad wagons, but until the present time there could not be established what connection exists between this and the absorption proprieties of the cattle cakes.

For this exact reason the research of the absorption proprieties of cattle cakes represents a practical and scientific interest of the outmost importance. In this paper we are showing the research results that we obtained from the experiments made on the hygroscopic proprieties of cattle cakes.

MATERIAL AND METHODS

The chemical structure of oleaginous cattle cakes depends on the chemical structure of the seeds and represents a complicated colloidal system with many components.

A researched sample of cattle cakes had the following characteristics (%):

- The gross protein content 49.6
- Gross oil content 4.9
- The peel content 13.3
- Humidity 6.7

The extractive substances and the ash were not determined.

The hygroscopic proprieties of cattle cakes were studied through the desiccators' method improved by Pestovoi N. E (PESTOV, 1987). The examined cattle cakes were crushed in a grinding mortar and then sifted in a 0.25 mm bolter, mixed and dried at a temperature of 105^0 in blankness for 16 hours until complete water elimination. Accurate weighted samples from the processed cattle cakes were put in Petri capsules or thin paper capsules of the same shape and were introduced in desiccators containing solutions that had different water vapor tensions. The capsules were placed at equal distances from the solution surfaces and the scientists followed the vapor absorption dynamics by the cattle cakes at a temperature of approximately 25^0.

The scientists placed chemically pure sulfuric acid in the desiccators with a concentration of 32, 42.5 and 52% and they also placed lead nitrate and sodium acetate. At a certain water vapor tension these solutions from the desiccators keep the relative humidity at a steady level during the whole experiment.

The lead nitrate slightly diminishes the vapor tension and the relative humidity of the air above a chemical like this approaches the relative humidity of the air above the water.

Absorption variation of water vapors through time by the cattle cakes was controlled through periodic weighting.

RESULTS AND DISCUSSIONS

The obtained data is showed in table 1.

Table 1

Vapor absorption related to time by the cattle cakes at different degrees of air dampness (g at 100g dehydrated cattle cakes)

Chemical	Pressure (mmHg)	Relative air humidity (%)	Weight addition (g at 100g cattle cakes)										
			After 15 hours	After 21 hours	After 36 hours	After 42 hours	After 57 hours	After 63 hours	After 111 hours	After 133 hours	After 148 hours	After 169 hours	After 193 hours
Saturated solution of $Ph(NO_3)_2$	23	98	7.2	8.8	11.4	12.8	15	15.9	18.9	20	20.7	21.6	23
Saturated solution of $NaCH_3COO^-$	18.2	76	6.5	7.5	9.2	9.5	10.4	12	12.4	12.4	12.6	12.6	12.6
H_2SO_4 – 32%	16.8	71	6.2	6.8	8.1	8.2	9	9.2	10	10.1	10.2	10.2	10.6
H_2SO_4 – 42.5%	12.2	51.5	4.6	4.8	5.0	5.2	5.4	5.4	5.5	5.6	5.6	5.6	5.6
H_2SO_4 – 52%	7.24	30.5	2.8	2.9	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4

From the table and from the figure we can see that at the beginning of the experiment there was intense vapor absorption by the cattle cakes at different relative humidity values of the air. In time the intensity of vapor absorption dropped with the drop of the relative humidity found above the cattle cakes samples. When relative air humidity has a high value almost at saturation level, the absorption process of vapors above the saturated solution of lead nitrate (W = 98%) is pretty significant after 10 days as well. In this case takes place the binding of water vapors through the absorbent elements and also capillary absorption of water as in the case of absorbent substances (JAKER , 1995).

After we established a balance in all the desiccators - when the weight remained the same, the sample of cattle cakes held above the saturated solution of lead nitrate (W = 98%) was passed in the desiccators with the saturate solution of sodium acetate (W = 76%) and kept there until the balance was established again. After the balance was fixed the sample was

passed in the desiccators with sulfuric acid 32% (W = 71%) and held until the balance was established again. So the sample of cattle cakes was consequently passed from desiccators to desiccators and it was established that while the vapor tension above the solution keeps on dropping the cattle cakes keep dehydrating more and more.

In this case the balance content of absorbed water for cattle cake saturation is smaller then at their dehydration – we can see the hysteresis phenomenon.

The obtained data are shown in table 2.

Table 2

The balance values of absorbed water by the cattle cakes at different air humidity

Number	Relative air humidity (%)	Balance content of humidity during vapor saturation (%)	Balance content of humidity during dehydration
1	98	24	-
2	76	12.6	12.8
3	71	11	12.2
4	51.5	7	9.4
5	30.5	4	7.4
6	15	2.5	4.6
7	4.3	1.1	-

We can see that when the cattle cake samples are kept a longer period of time above a solution at a relatively high humidity a fungus is born on the cattle cakes surface and a musty smell appears. As long as the fungus keeps growing the cattle samples become lighter.

Establishing the limit of relative air humidity under which the fungus stops growing so that it doesn't cause cattle cake alteration is a practical problem. To this purpose the cattle cake samples were held for a long time (60 days) in the desiccators above solutions with vapors that have different tensions at temperatures of approximately 25^0.

The data obtained after this experiment is found in table 3. Besides researching the hygroscopic proprieties of the cattle cakes that was done in the laboratory, observations were made concerning water absorption from air by the cattle cakes while being in storage.

Observations were made concerning humidity variation in two lots each one of 15 tones of cattle cakes. After processing in the snail press the cattle cakes humidity was 2.01 and 2.16% and after being stored for 10 days the humidity rose at respectively 3.12 and 2.91%. The humidity of the crushed cattle cakes from these lots was bigger: at the first lot it was 3.41 and at the second lot 4.33%. The scientists also examined the dust that came from the crushed cattle cakes after a long storage period. The humidity of this dust was 7.13%

The relative humidity of the air was not determined. As we can see in table 3 the grinded cattle cakes absorb, from the air, approximately 11% water at a relative humidity of 71%. According to the technological process of oil fabrication the sun flower seeds are mostly pealed, then grinded at platens and fried at a temperature above 100^0C. From the research we see that the grinding and frying temperature was around 125 – 136^0C before passing through the snail presses for oil making.

In the oil squeezing process there is a high pressure in the snail presses. At the same time takes place the rubbing of the squeezed material on the strainer walls and on the surface of the snail axle and thus the temperature rises considerably and sometimes reaches 140 – 150^0C. After the cattle cakes get out from the snail press we witness a drop in temperature. The water

contained by the cattle cakes evaporates intensely (ELCENKO, 1992) because of the high temperature enlarging the cattle cakes porosity.

Table 3

Equilibrium humidity of the cattle cakes and the maximum relative humidity of the air, that creates favorable conditions for fungus growth after a longer storage period

Chemical	Vapor elasticity (mmHg)	Relative air humidity (%)	Weight addition (g at 100g cattle cakes)	
			After 10 days	After 60 days
Saturated solution of $Pb(NO_3)_2$	23	98	24.2	Fungus
Saturated solution of $KHSO_4$	20.4	86	-	Fungus
H_2SO_4 – 23%	19.7	83	12.9	Fungus
Saturated solution of $H_2C_2O_4$	18.2	76	-	Fungus
H_2SO_4 – 32%	16.8	71	10.7	11
H_2SO_4 – 42.5%	12.2	51.5	5.6	7
H_2SO_4 – 52%	7.24	30.5	3.6	4
H_2SO_4 – 60%	3.56	15	-	2.5
H_2SO_4 – 70%	1.03	4.3	-	1.1
H_2SO_4 – 80%	0.124	0.52	-	0.9
H_2SO_4 – 90%	0.007	0.032	-	Almost null

After the temperature of the cattle cakes is down the dehydrating process stops and the reverse process begins vapor absorption while in storage.

From the research made in the laboratory and from the data collected during the fabrication process we can say that the cattle cakes with a low humidity degree obtained from the oil extraction process have the propriety to absorb appreciable quantities of vapors from the surrounding atmosphere.

CONCLUSIONS

From the research made by the laboratory and from the data collected during the fabrication process we conclude that the cattle cakes that have low humidity and that are obtained from the oil extraction process have the ability to absorb appreciable quantities of vapors from the surrounding atmosphere.

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