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Miten määritään kosteus suussa?

Some Drying Technical Aspects of Salami Production

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Salami is preserved by the concentration through dehydration of the salt content, added to the emulsion. Thus the preservation of salami is essentially a drying procedure, where the character of changes is greatly dependent on conditions of drying, such as temperature, relative humidity, drying rate, etc.

To chieve optimum conditions it is necessary to direct and control the drying procedure according to a preconceived plan /1,2/. In order to be able to do this the mechanism and the material characteristics of drying have to be elucidated and it is necesarry to construct an equipment in which the optimum program may be carried out.

The mechanism of drying

The drying process of salami falls into four phases:

In the first phase the drying effect reaches the border of the emulsion. Dependent of i intensity of drying and k_b moisture gradient is formed.

The intensity of drying is proportionate to the difference between u_f surface and u_e equilibrium humidity where the coefficient for moisture exchange: β is the proportionality factor.

By neglecting thermodiffusion /3/:

$$i = k_b \cdot /vu/_f = \beta/u_f - u_e/$$

In the second phase of drying the vapour tension is reduced below equilibrium and the drying of the emulsion begins. The second phase is finished when drying reaches the middle line. Moisture distribution at the end of the second phase is dependent on i and k_p values of the emulsion.

The first two phases of drying may be called the starting period /4/.

In the third phase of drying the character of moisture distribution and some drying characteristics remain constant. The drying coefficient -neglecting thermodiffusion and the change in the moisture content of the casing - /3/ is:

$$i = k_p \cdot \gamma_{op} \cdot \left/ \frac{\partial u}{\partial r} \right/_f$$

where k_p = the moisutre conduction coefficient in the emulsion

γ_{op} = the density of the dry emulsion.

This third phase ends when the permitted humidity value of the surface is reached.

In the fourth phase of drying the moisture content of the inner layers is reduced.

Initial and boundary conditions

The initial conditions of drying -after the emulsion has been stuffed in casings are: the temperature of the emulsion, the formula used and its initial moisture content, the character of the casing and its initial moisture content.

Boundary conditions of drying are: the consistency of the emulsion, the applicable temperature and relative humidity boundaries in relation to biochemical processes, the time needed for aging, and the highest moisture gradient permissible. The value of the highest moisture gradient is limited by the danger of fissures in the internal layers. The stress caused by the uneven shrinking of the emulsion is a function of the moisture gradient /∇u/, the shrinking coefficient /α/ and the modulus of the elastic /E_r/ and elasto-plastic /E_{rp}/ linear deformation of the emulsion:

$$\sigma_h = \sigma_h /\nabla u, \alpha, E/.$$

The properties wanted for the planned direction of the drying process. In accordance with the above the knowledge of the following characteristics is important:

a/ equilibrium humidity values /desorption isotherms/
b/ moisture coefficients /β, k/
c/ shrinking coefficient / α /.
d/ firmness characteristics /σ_h, E/

a/ Sorption isotherms belonging to salami /5/.

The drying effect of the environment is transmitted to the surface of the emulsion by the casing, therefore from the point of view of sorption equilibrium, the role of the casing is definitive.

During drying the casing is penetrated by salt and thereby the pertinent equilibrium relative lumidity value changes. The desorption isotherms belonging to the natural casing prepared from the alimentary tract of horses, and to protein and cellophane based artificial casings, respectively, were investigated.

The desorption isotherms of casings are of sigmoid form and colloidal-capillary character /Figure 1./.

The isotherms belonging to the emulsions show a similar phase /Figure 2./.

b/ Coefficients belonging to moisture conduction and exchange /6/.

Moisture conduction in the casings takes chiefly the form of vapour diffusion. Moisture conduction coefficients were determined by the stationary moisture flow method. Their value dependent on the quality of the casing varies between $k_b = 1,8$ and 9.5×10^5 m²/h.

As regards the moisture conduction of emulsions it was shown that the coefficients belonging to emulsions made of ground beef were 2-3 times greater than the ones belonging to emulsions prepared from pork. The $k.\gamma_{op}$ values, belonging to pork emulsion at 15° C within the limits $1:2.10^{-4}$ and those belonging to beef emulsion $3:4.10^{-4}$ kg/mh were in the W = 70% range approximately constant at an initial fat content of 32%. These values increase with increasing moisture content. Thus, it is shown that the drying of beef emulsion has a lesser moisture gradient.

With rising temperatures the moisture conduction coefficients increase.

With increasing fat content increases the $k\gamma_{op}$ value.

The β moisture exchange coefficient was derived from drying curves. The value of β increases with decreasing moisture content. By increasing the air velocity and the angle of air blast increases the coefficient /Figure 3./.

c/ Shrinking conditions.

In the first phase of drying the casing shrinks only. Shrinking hindered by the volume of the emulsion causes overstress and in the case of rapid drying the casing may burst. In the second phase of drying the dehydration of the emulsion begins and the moisture content of the casing is reduced to the equilibrium level.

In the third phase of drying the shrinking of the emulsion continues and the casings, particularly artificial casings of less adequate shrinking capacity, shrivel. In this phase, as well as in the fourth phase of drying the casing because of moisture uptake may get detached.

The rate of shrinking /6/ is not constant during drying. The rate of shrinking is slowest at the beginning of the process, a useful property, and grows with the advance of drying. In the critical range of moisture the shrinking conditions change /Fig.4./. From the third phase of drying the shrinking of the emulsion, at the same time that of the whole bar of salami, is of linear character. In emulsions prepared from pork the shrinking coefficient along the diameter is $\alpha_\phi = 2,6 \cdot 10^{-3}$ /in beef based emulsions $\alpha_\phi = 1,6 \cdot 10^{-3}$/. The coefficients of longitudinal shrinking $\alpha_h = 1,5 \cdot 10^{-3}$ and $1,0 \cdot 10^{-3}$, respectively.

d/ <u>Firmness of the emulsion /7/</u>

The load curves obtained from breaking tests belonging to emulsions of varied composition and moisture content proved that the elasticity limit, the E_r and E_{rp} moduli and the load capacity /σ_h/ grows with growing moisture content. The load capacity of the emulsion prepared from beef was twice as high as that of pork /Fig. 5./, therefore the former may be dried at a higher moisture gradient, or in other words it is less sensitive. The firmness of the emulsion is a static probability corresponding to the texture of meat grains, i.e. to their spacing relative to fat grains and it is affected by the amount of fat added.

Practical conditions of the planned control of the drying process

In accordance with the initial and border conditions the W /T/ optimum drying program of a given kind of goods may be established. This may be carried out, the given air-technical apparature taken into consideration, with the aid of a definite air conditioning program.

The air conditions wanted, uniform air distribution and air replacement, have to be provided by the air conditioning equipment, irrespective of meteorological factors. In Hungary two types of equipment based on different principles are in use.

The Marton equipment applies physical adsorbent and recirculation and has two, alternately operating, i.e. regenerated gel-chaimbers /8/. Uniform air distribution is assured by free air-flow between salami bars.

Our own system takes advantage of the outside air when the conditions are suitable by mixing in fresh air. In the summer it applies recirculation and cooling. To attain uniform air distribution air ducts are provided /9, 10/.

In the konwledge of the theoretical and practical requirements the most advanced form of direction, automated programing may be applied.

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List of Figures:

Figure 1. DSI: Desorption Isotherms

DSI-s for various casings at 15° C.

1. o Horse casing
2. x Cutisin casing
3. + Hungarian artificial casing
4. △ Faser artificial casing.

Figure 2. DSI for the emulsion at 15°C

/pork, W_o= 100%, fat: 31.5 %/

NaCl per dry weight: 6.16%.

Figure 3. Moisture exchange factors in various casings.

σ_{sz}: NaCl per dry weight/

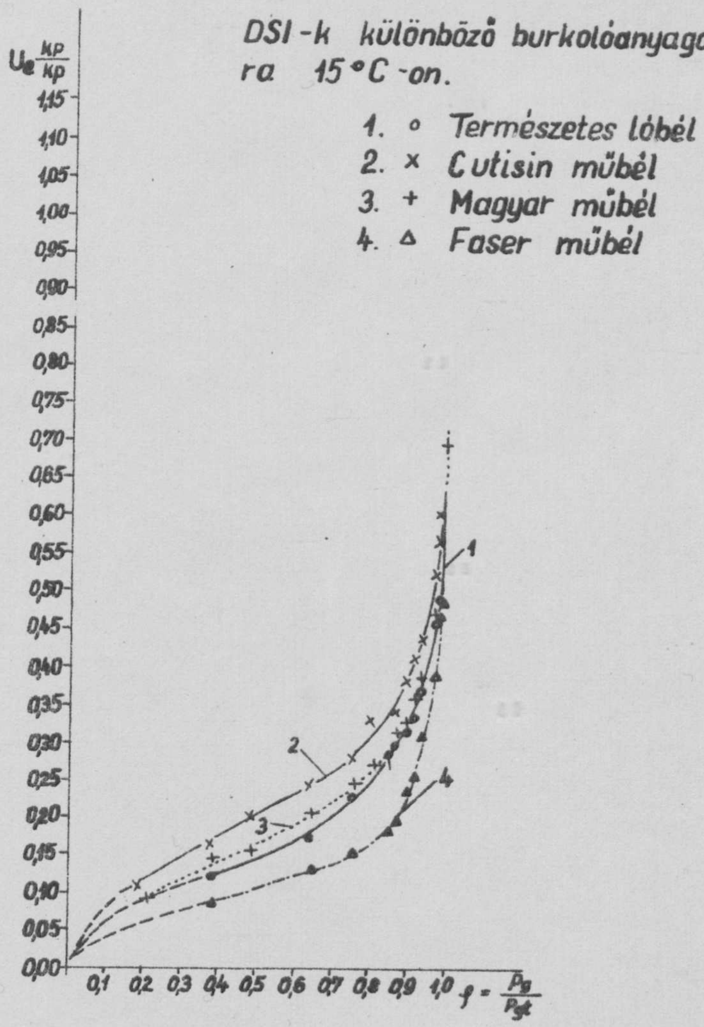
1. o Horse casing v_1=0,5 m/s σ_{sz}=4,2% α=90°
2. x Hungarian artificial casing v_1=0,5 m/s σ_{sz}= =9.8% α=30°
3. ◻ Cutisin artificial casing v_1=0,5 m/s σ_{sz}=6.5% α = 15°
4. + Faser artificial casing v_1=0,5 m/s σ_{sz}=5.6% α = 20°

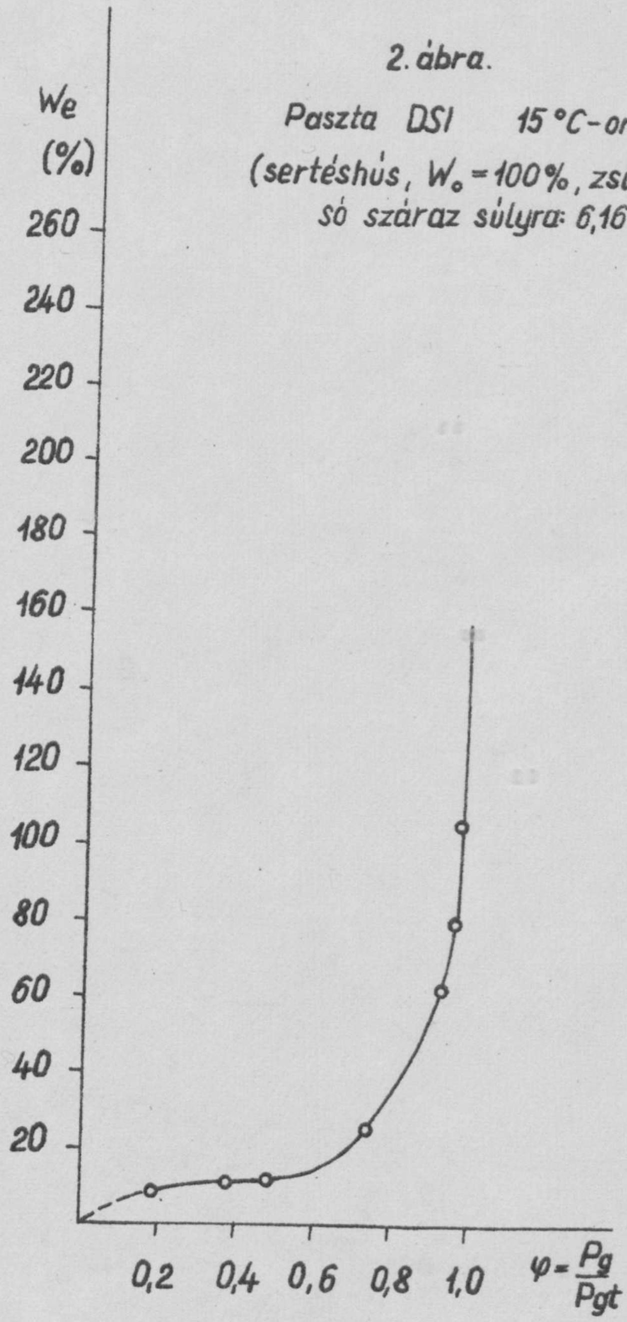
Figure 4. Surface shrinkage of various-casings.

1. x Hungarian artificial casing: v_1=0,0 φ=63 %
2. △ Horse casing: v = 0,0 φ=47%
3. + Cutisin artificial casing: v_1=0,0 φ=63 %
4. o Faser artificial casing: v_1=1,1m/s φ=40 %.

1. ábra.

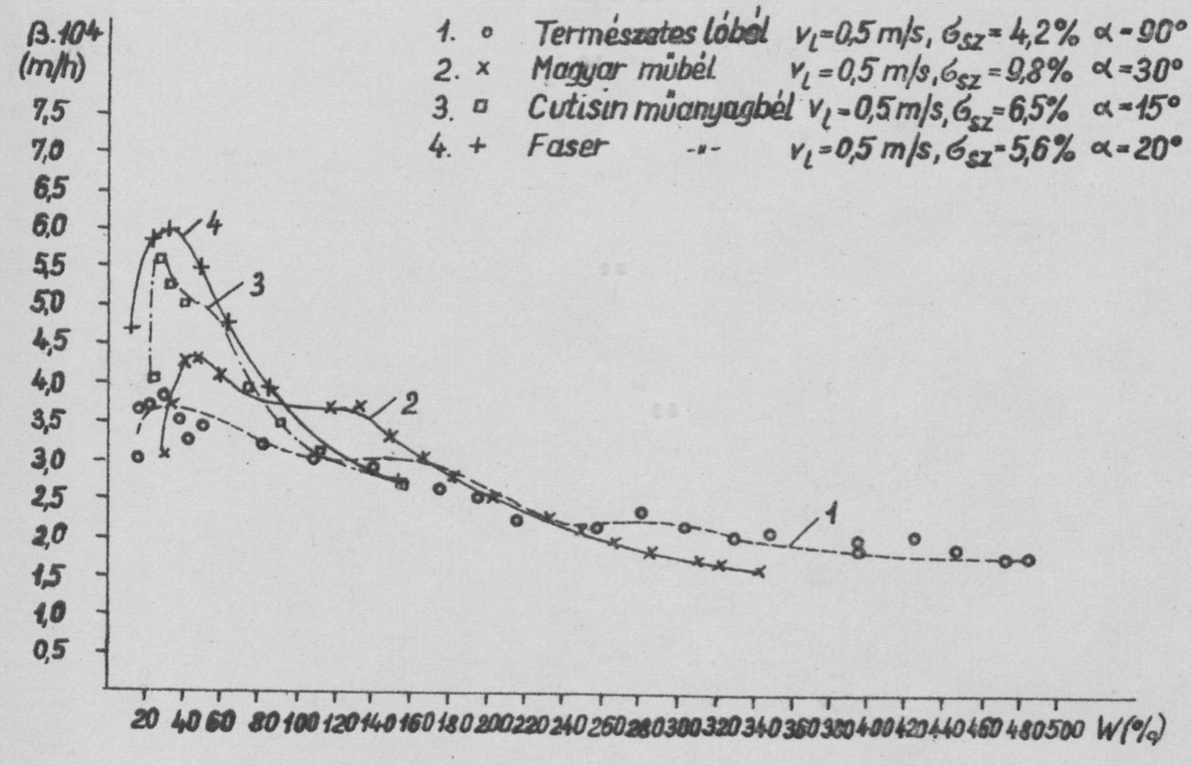
DSI-k különböző burkolóanyagokra 15 °C-on.





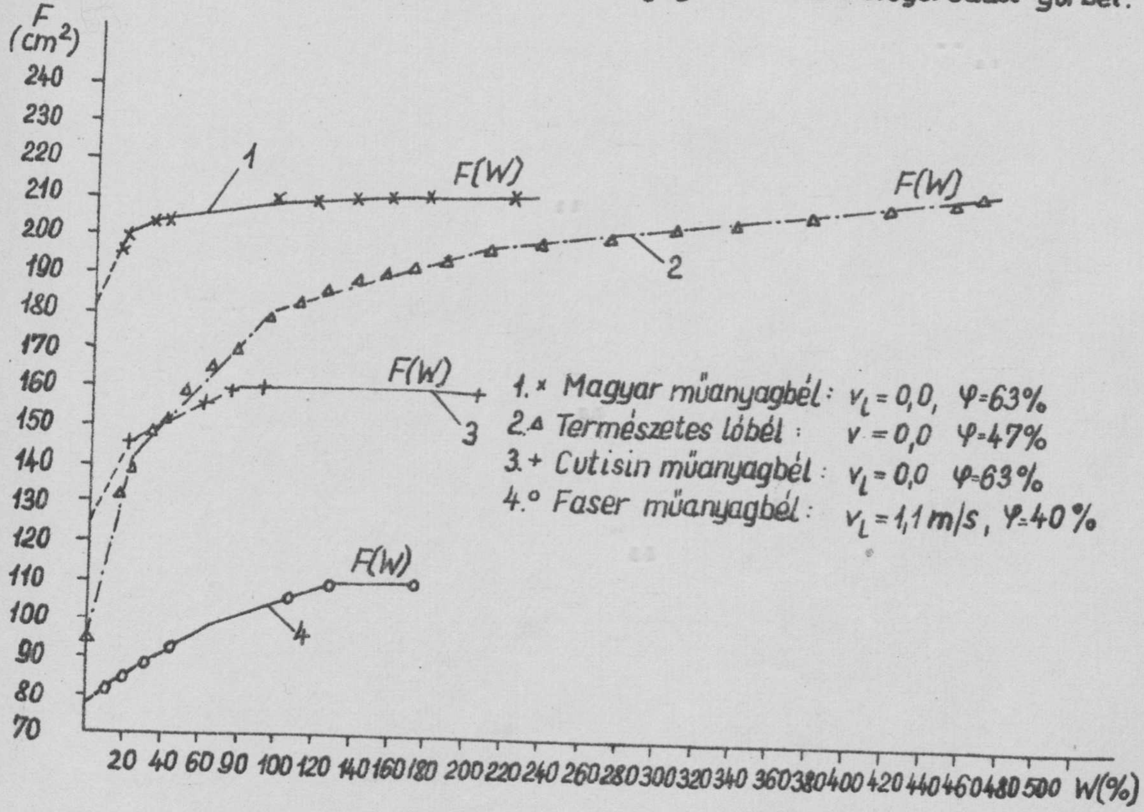
2. ábra.
Paszta DSI 15 °C-on
(sertéshús, W_o = 100 %, zsír: 31,5 %)
só száraz súlyra: 6,16 %

3. ábra.
Különböző burkolóanyagok nedvességcsere tényezői.
(σ_{sz}: só száraz súlyra vonatkoztatva)



4. ábra.

Különböző burkolóanyagok felületi zsugorodási görbéi.

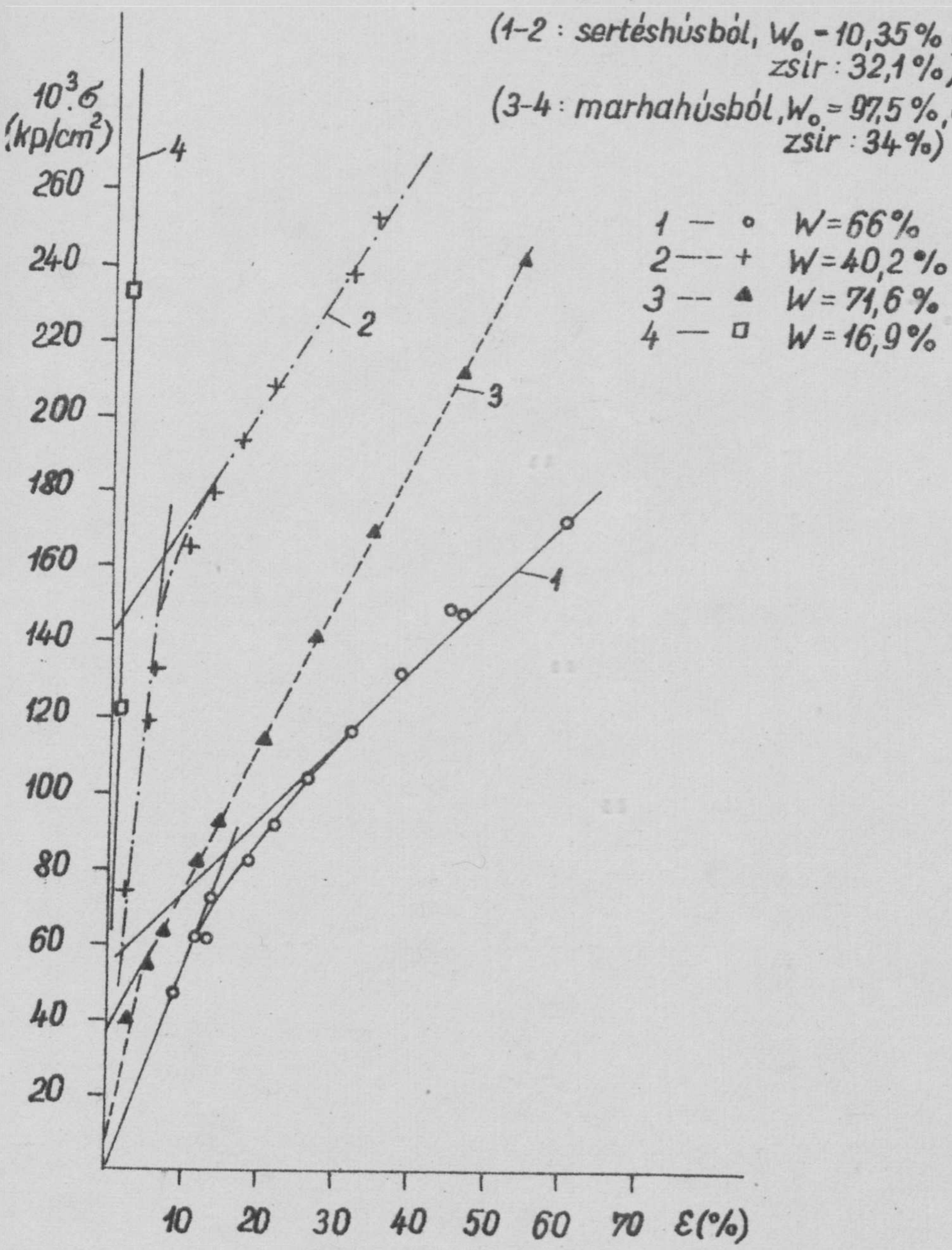


5. ábra.

Különböző paszták terhelési diagrammjai

(1-2 : sertéshúsból, W_0 - 10,35 % σ_{sz} = 6,0% zsir : 32,1 %)

(3-4 : marhahúsból, W_0 = 97,5 %, σ_{sz} = 5,7% zsir : 34 %)



Über einige trocknungstechnische Fragen der Behandlung von Salamiarten

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Die äusseren und inneren Eigenschaften der Ware werden von der Durchführungsweise des Trocknungsprozesses beeinflusst. Optimale Verhältnisse können durch eine planmässig durchgeführte Trocknung erzielt werden.

Der Trocknungsprozess kann nach der Art der Hülle und der inneren Wasserverteilung in vier Perioden aufgeteilt werden. Bei den einzelnen Perioden sind die vom Brät und von der Hülle bestimmten Anfangsbedingungen, ferner die von der Konsistenz und von den biochemischen Gesichtspunkten bestimmten Grenzbedungungen zu berücksichtigen.

Zur Ausarbeitung des Programmentwurfes der Trocknung muss man die Trocknungscharakteristika des Stoffes kennen. Das Feuchtigkeitsgleichgewicht wird von der Hülle bestimmt. Die Desorptionsisothermen mancher Hüllen werden von der während der Trocknung der Hülle auftretenden Änderung des Kochsalzgehaltes beeinflusst. Die Isothermen der Hülle haben einen kollid-kapillaren Charakter.

Die Feuchtigkeitswanderung in der Hülle erfolgt während einer bedeutenden Periode der Trocknung in Form von Dampfdiffusion. Die Feuchtigkeitswanderungsfaktoren der aus Rindfleisch hergestellten Füllmassen sind 2-3mal höher, als die der aus Schweinefleisch verfertigten Füllmasse.

Die Faktoren des Feuchtigkeitsaustausches der Hülle erhöhen sich mit der Herabsetzung der Feuchtigkeit, bzw. mit der Erhöhung der Luftgeschwindigkeit.

Das Schrumpfen der Hülle wird mit dem Fortschreiten der Trocknung stärker. Das Schrumpfen der Füllmasse ist von der dritten Periode der Trocknung beginnend linear.

Die Festigkeit der Füllmasse erhöht sich mit der Verminderung des Wassergehaltes. Die Festigkeit der aus Rindfleisch hergestellten Füllmasse ist etwa zweimal höher, als die der aus Schweinefleisch verfertigten Füllmasse.

Zur Durchführung des Programms sind Klimaanlagen unerlässlich. Die höchstentwickelte und wirtschaftlichste Art der Steuerung ist die Automatisierung des Programmes.

О НЕКОТОРЫХ ВОПРОСАХ ТЕХНИКИ СУШКИ КОЛБАСНЫХ ИЗДЕЛИЙ.

(В Ы В О Д Ы)

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Способ проведения процесса консервирования сушки оказывает влияние на внешние и внутренние показатели продукта. Оптимальные условия процесса обеспечиваются планомерным проведением сушки.

Процесс сушки можно распределить на четыре основные фазы характеризирующие распределение влаги в оболочках и внутри продукта. При фазовом процессе сушки необходимо учесть начальные условия установленных фаршом и оболочкой, а также пределы допустимых требованиями изменений консистенции и биохомических показателей.

Чтобы составить программу сушки, необходимо ознакомиться с параметрами (показателями) материала подлежащего сушке. Равновесие влаги устанавливает оболочка. На изотермы десорбции одиночных оболочек оказывают влияние изменения содержания соли во время высыхания оболочек. Изотермы оболочек соответствуют коллоидно-капиллярным показателям.

Влагопроводность в оболочке в значительной части процесса сушки осуществляется в форме диффузии пара. Коэфициенты влагопроводности фарша изготовленных из говяжего мяса в 2-3 раза выше чем в фарше изготовленного из свинины.

Коэфициенты обмена влажности оболочек увеличиваются с уменьшением влажности и увеличением скорости воздуха.

Сморщивание оболочек увеличивается с уменьшением влажности. Плотность фарша изготовленного из говяжего мяса приблизительно в два раза выше плотности фарша изготовленного из свинины.

В процессах программы необходимо применять кондиционер. Самым развитым и экономным способом управления сушки является автоматически управление программы.

T a b e l l e VI   R o h w u r s t

Rohmasse

Anfangskeimzahl : $6{,}0 \times 10^{6}$

Impfmenge/g

P 162	$8{,}0 \times 10^{15}$
P 192	$2{,}5 \times 10^{14}$
431	$8{,}0 \times 10^{10}$
451	$2{,}5 \times 10^{7}$
PC	$2{,}5 \times 10^{10}$

Rauchtemperatur 26°C

Fett	34,46 %
Wasser	48,02 %
NaCl	2,77 %

Alter	Stamm No.	Total Aerobe	SZ	pH	Organolept. Bewertung a b c	Bemerkungen
1 Tag	Kontr.	$9{,}5 \times 10^{6}$	2,6	6,0	2 3 3	Rand grau
	P 162	$4{,}0 \times 10^{8}$	2,4	6,0	3 3 3	
	P 192	$8{,}5 \times 10^{8}$	2,4	6,0	3 3 3	
	431	$3{,}5 \times 10^{8}$	2,5	5,9	3 3 3	
	451	$4{,}5 \times 10^{8}$	2,2	5,9	3 3 3	
	PC	$1{,}7 \times 10^{8}$	2,6	5,9	3 3 3	
2 Tage	Kontr.	$8{,}5 \times 10^{8}$	3,22	5,7	4 3 3	
	P 162	$1{,}3 \times 10^{10}$	3,35	5,5	4 3 3	
	P 192	$1{,}0 \times 10^{10}$	2,47	5,6	4 3 3	
	431	$1{,}7 \times 10^{10}$	3,42	5,6	4 3 3	
	451	$7{,}0 \times 10^{9}$	2,56	5,6	4 3 3	
	PC	$1{,}7 \times 10^{9}$	2,94	5,9	4 3 3	
9 Tage	Kontr.	$3{,}0 \times 10^{9}$	4,0	5,4	4 4 4	
	P 162	$6{,}0 \times 10^{9}$	4,2	5,5	4 4 4	
	P 192	$1{,}5 \times 10^{10}$	4,7	5,5	5 4 4	
	431	$3{,}2 \times 10^{9}$	4,8	5,6	4 4 4	
	451	$1{,}2 \times 10^{10}$	4,5	5,6	4 4 4	
	PC	$4{,}0 \times 10^{10}$	4,6	5,4	4 4 4	
18 Tage	Kontr.	$5{,}0 \times 10^{9}$	6,9	5,4	5 4 4	
	P 162	$2{,}5 \times 10^{10}$	7,5	5,4	4 4 4	
	P 192	$2{,}2 \times 10^{10}$	6,0	5,4	5 4 4	
	431	$5{,}0 \times 10^{9}$	6,4	5,5	4 4 4	
	451	$1{,}3 \times 10^{10}$	7,1	5,5	4 4 4	
	PC	$2{,}7 \times 10^{10}$	6,0	5,3	4 4 3	