FACTORS DETERMINING CONSISTENCY IN THE DRY-CURED HAM

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Background

Consistency is one of the important attributes in dry-cured ham. In the first place, the product has to be firm to make slicing into very thi slices possible that are nearly transparent and to do not disintegrate. During consumption the product should be firm and demonstrate moderat resistance to mastication that exhibits that full aroma of the fermented meat. In can neither be too soft, as in the case of products insufficientl dehydrated nor too hard as it can be found in the products over-dehydrated due to prolonged storage.

The purpose of study was the determination of factors that affect the development of consistency and its formation in dry-cured ha during production process.

Objectives

Fourteen porcine hams of Polish Large White breed obtained from animals slaughtered at various age and demonstrating different bod weight were used as experimental material. The hams were deboned and formed in the shape of "Westfalia ham". Thereafter they were treated o the surface with a mixture of halite and evaporated salt, sodium nitrite and nitrate, starter cultures and glucose. Curing procedure was carried ou at 6-8 ^{0}C temperature and 85-90% relative humidity for 53 days. After that time hams were rinsed to remove excess salt and dried to reac around 78% of the ham initial weight. Drying was conducted at 1 to 12 ^{0}C temperature and the relative humidity was 90% at the end. The drie hams were packed into barrier film bags and stored for six months. After that period they were subjected to various analyses.

Besides, from two other hams the largest muscles were excised and cut into thick slices. One slice from each muscle was examine immediately after excision (4) and the others (12) were salted with an excess of sodium chloride, stored for one there weeks and during th period the occurring juice was removed. Thereafter the muscle slices were packaged into plastic film bags and air evacuated. During th subsequent ten days storage the salt concentration and water content have been equalised in the muscle slices and consistency examinatio followed. Those slices were used as a model of ham meat of various degree of dehydration during the processing procedure of dry-cured ham.

Methods

Instrumental examinations of consistency by CASRA method (Tyszkiewicz, Olkiewicz, Daun 1994) were carried out parameters o plasticity (P), elasticity (E) and fluidity (F) estimated. Moreover, additional parameters i.e.: deformation under modular (minimal) stress (D_{min} deformation under stress resulting in irrecoverable destruction of meat structure (D_{plast}) were determined and specific analytical procedure UTM Zwick model 1445 was used (Tyszkiewicz and Olkiewicz 1998). Samples in the form of ham slices were placed first onto metal suppo furnished with pins 20 mm high and 2 mm Ø distributed every 15 mm according to the plane of a hexagonal net and then sample thickness wa adjusted to 20 mm acc. To the method described in the paper cited above. Thereafter samples in the hexagonal muscle fragments were subjecte to penetration by using a mandrel of rectangular cross-section 2x6 mm.

The other measurement conditions were as follows: 1) traverse velocity between bites: 120 mm/min and over bite duration: 2 mm/mi 2) force unit: F_1 = 1N; 3) force increment: 1N; 4) stress and relaxation time – t_0 = 15s each time; 5) mandrel surface area: S = 1,2 x 10^{-5} m Chemical composition of ham meat samples was also determined: protein content by Kiejdahl method (B), water content by drying to consta weight (W): and intramuscular fat by Soxhlet method (T). Meat pH was measured using pH-meter with sharp-end electrode. Sensory evaluatio of ham meat was conducted by a trained sensory panel of 6 to 7 judges and five-score scale was used. Among other, consistency intensity (IK and consistency desirability (PK) were evaluated.

Results and Discussion

1. **Usefulness of texture rheological parameters in the assessment of the physical status of ham muscles in dehydration and ageing process**

The degree of meat dehydration is well characterized by the ratio of water to protein content (W/B). Correlations of the results of th particular rheological texture parameters: P, E, F, D_{min} and D_{plast} were examined with their relation to the population of results representing: raw ham muscles (4), salted and partially dehydrated ham muscles (12) and hams after curing and ageing.

The only one applicable and multi-purpose indicator was found to be the parameter D_{min}. Its linear correlation coefficient with W/B ratio amounted 0,865. In the case of the other parameters, the absolute values of the correlation coefficients amounted from 0,220 to 0,521. The even more close relationship between D_{min} and W/B can be obtained taking into consideration the non-linear relationship described by the equation:
Log 10 x D_{min} = - 0,226 + 0,814 (W/B) and R = 0,899; Log 10 x D_{min} = - 2,961 + 2,986 (W/B) – 0,407 $(W/B)^2$ and R = 0,915

2. **Relationship among texture rheological parameters and sensory evaluation of ham texture**

It was found that there is a great relationship among the majority of rheological parameters of texture and the consistency intensi evaluated by sensory method. The highest statistically significant correlation coefficient was observed for plasticity P (0,903), fluidity F (-0,829 elasticity E (-0,821) and D_{min} index (-0,736). In the case of D_{plast} parameter, it was found statistically not significant. Consistency intensity was closely correlated with the evaluation of consistency desirability IP (-0,905). The negative correlation coefficient denotes that the higher consistency intensity of ham meat the lower its desirability.

3. Factors determining ham consistency

Correlation coefficients among texture rheological parameters and texture intensity and the studied traits that characterize ham are shown in the table1.

Ham weight (M) and meat pH value has to be regarded as factors that determine, to the highest extent, ham consistency. The W/B ratio was found to be greatly correlated with ham weight, as it has been expected, and it may not be treated as an independent variable, since that would be without sense.

The relation of texture rheological parameters and texture intensity with ham height (M) and pH can be described by the equations:
$P\ [x10^5\ N/m^2] = 43,349 - 2,092\ pH - 2,940\ M$ and $R = 0,809$; $E\ [x10^{-7}\ m^2/N] = -3,299 + 0,627\ pH + 0,280\ M$ and $R = 0,796$; $F\ [x10^{-8}\ m^2/Ns] = -2,361 + 0,509\ pH + 0,389\ M$ and $R = 0,908$; $D_{min}\ [x] = -16,437 + 2,297\ pH + 1,545\ M$ and $R = 0,936$; $IK\ [x] = -2,575 + 1,822\ pH - 0,957\ M$ and $R = 0,689$

Conclusions

1. The deformation at minimal stress (D_{min}) was found to be only multi-purpose indicator of the rheological status of dry-cured ham muscles in various stages of the processing procedure.
2. High relationship was noted between the sensory evaluation of ham consistency and the rheological texture parameters analysed by CASRA method, i.e. plasticity P; fluidity F; elasticity E and D_{min} indicator.
3. Sensory evaluation revealed that higher consistency intensity in the ham muscles the lower consumer preference scores.
4. Ham weight M and pH had the highest effect on consistency rheological parameters and texture intensity evaluated by sensory analysis.

Pertinent literature

1. Tyszkiewicz S., Olkiewicz M, Daun H. 1997, Multiparametric method for the rheological evaluation of meat and other solid food. J. Texture Studies 28, 337 348
2. Tyszkiewicz S., Olkiewicz M. 1998, Meat Consistency changes caused by dehydration and salting in the production of raw ripening ham. Proc. 44th ICoMST, Spain, 974-975

Table Correlation coefficients between texture rheological parameters, texture intensity and studied traits

	Plasticity (P) [$x10^5\ N/m^2$]	Elasticity (E) [$x10^{-7}\ m^2/N$]	Fluidity (F) [$x10^{-8}\ m^2/Ns$]	D_{min} [%]	IK [pc]	Ham weight [kg]	W/B	pH
Ham weight (M kg)	-0,808	0,788	0,905	0,932	-0,675			
W/B	-0,577	0,701	0,477	0,445	-0,522	0,837		
pH	-0,700	0,721	0,803	0,832	-0,491	0,383	0,299	
Fat content -T (%)	-0,452	0,349	0,476	0,384	-0,382	0,334	0,354	0,211

Fig. 1 Biplot for the variables in multivariate space

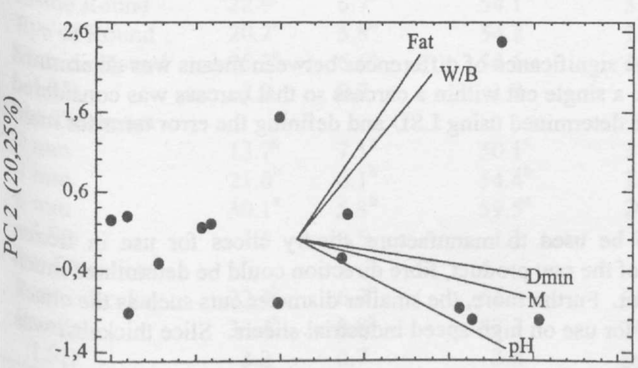

Fig. 2 Biplot for the variables in multivariate space