THE INFLUENCE OF RAW MATERIAL PROPORTION AND SOME PROCESS VARIABLES ON THE PROPERTIES OF LIVER SAUSAGE

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In this investigation the influence of variations in the liver-fat-water proportion, as well as the influence of chopping temperature and comminution of the liver on the stability and sensoric properties of liver sausage have been studied.

For the preparation of the liver sausage different methods have been chosen. The raw materials used, were pork liver, pork cheek (fat), water and salt, containing 0.6% sodium nitrite. Also some other pork fat tissues have been investigated.

The influence of chopping temperature on the stability and consistency of liver sausage, appeared among others, to depend on the water-fat proportion. Also the degree of liver reduction has been found to influence these parameters.

A production method whereby the liver was incorporated into an emulsion of the pre-cooked fat, water and milk proteins, appeared to give the greatest degree of freedom in choosing the liver-fat-water proportion in the recipe.

L'INFLUENCE DE LA COMPOSITION ET DE QUELQUES VARIATIONS DANS LE PROCÉDÉ DE FABRICATION SUR LES PROPRIÉTÉES DU SAUCISSON DE FOIE

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Dans cette recherche l'influence de la proportion foie-graisse-eau, ainsi que l'influence de la température de cutterage et le degré de désintégration du foie sur la stabilité du saucisson de foie ont été étudiés. Cette influence sur les propriétés sensorielles a été déterminée également.

Les differentes méthodes de fabrication ont été comparées. Les matières crudes utilisées dans cette recherche, étaient foie de porc, graisse de tête, eau et sel nitrité. Egalement quelques autres types de graisse ont été examinés.

L'influence de la température de cutterage sur la stabilité et la consistance du saucisson de foie se trouvait dpendant de la proportion graisse:eau.

Le degré de désintégration du foie avait aussi une influence distincte sur les deux paramètres.

La méthode de fabrication dans la quelle la graisse pochée est émulsionnée dans l'eau au moyen de la lacto-proteine, avant l'addition du foie, montre qu'il est possible defoire les plus grandes variations de composition.

DER EINFLUSS DER REZEPTURZUSAMMENSETZUNG UND EINIGER PROZESSVARIABLEN AUF DIE EIGENSCHAFFTEN VON LEBERWURST

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In diesen Versuchen wurde der Einfluss der Leber-Fett-Wasser-Proportion, der Kuttertemperatur und des Zerkleinerungsgrades der Leber auf die Stabilität und die sensorischen Eigenschafften der Leberwurst untersucht.

Für die Herstellung der Leberwurst wurden unterschiedlichen Produktionsverfahren verglichen. Die gebrauchte Rohmaterialien bestanden aus Schweineleber, Backenspeck, Wasser und Nitritpökelsalz.

Der Einfluss der Kuttertemperatur auf die Stabilität und die Konsistenz der Leberwurst erschien abhängich der Fett-Wasser proportion. Auch der Zerkleinerungsgrad der Leber zeigte einen Einfluss auf diese Parameter.

Ein Produktionsverfahren, bei dem die Leber einer Emulsion aus dem gebrühten Speck, Wasser und Milcheiweiss zugegeben wurde, ergab die grösste Freiheit in der Rezepturzusammenzetzung.

ВЛИЯНИЕ СОСТАВА И НЕКОТОРЫХ ПЕРЕМЕННЫХ ПРОЦЕССА НА СВОЙСТВА ЛИВЕРНОЙ КОЛБАСЫ

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В этом исследовании изучалось влияние вариаций в соотношении печенка-жир-вода,а также влияние температуры изготовления и метода размельчения печенки на стабильность и сенсорные свойства ливерной колбасы.

Сравнивались различные методы изготовления ливерной колбасы. Применялись свинная печенка,челюстной жир,вода и кухонная соль с 6%-ым содержанием нитрита натрия. Применялись в нашем исследовании и некоторые другие свинные жиры.

Влияние температуры изготовления на стабильность и консистенцию ливерной колбасы оказалось,наряду с другими факторами,зависимым от соотношения вода-жир. Степень размельчения печенки также имела явное влияние на оба параметра. Метод изготовления,при котором из распаренного жира,воды и молочного белка приготовлялась эмульсия,в которой перерабатывалась печенка,оказался дающим наибольшую свободу действий,что касается состава ливерной колбасы.

THE INFLUENCE OF THE COMPOSITION AND OF SOME PROCESS VARIABLES ON THE PROPERTIES OF LIVER SAUSAGE

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INTRODUCTION

Liver sausage is made in many recipe varieties ranging in liver content from as high as 50 %, to products in which the quantity of liver only amounts to approximately 15 %. The first category consists of products, which mainly contain liver and fat, whereas the products with low liver content may contain considerable quantities of broth, milk or water. In addition to liver, water and fat, these products may also contain cooked meats and varieties, such as rinds and stomachs, of which the quantity normally increases with decreasing amount of liver. Ingredients, such as cooked meats, may be chopped or ground very finely, or can be added in coarse pieces, leading to different types of finished products. Depending on recipe and production method, the final products may be either spreadable, slicible or slicible and spreadable.

It is well-known to meat technologists, that the sausage composition, the production method, production temperature etc. have great influences on the characteristics of the final sausage product and may even be decisive for the succes of the finished article.

It was the aim of this work to investigate the influence of variations in composition and raw materials and some process variables on the stability, texture and sensoric properties of liver sausage.

MATERIALS AND METHODS

The area to be investigated is very extensive and has therefore been divided into parts. The first part, which will be reported here, is restricted to the finely comminuted products, consisting of the raw materials of first importance, i.e. liver, fat, water and salt. The majority of the experimental series was performed with fresh pork liver and cheek fat, although in special series also the behaviour of deep frozen liver, flare fat and soft belly fat were studied.

The fat tissues were minced through a 25 mm. disc, thoroughly mixed and weight out for the various production batches. Shortly before sausage production the fat was cooked in water, 30 minutes at 90°C. The cooking water was used as "broth".

The liver was pre-chopped with 1,8 % nitrite salt, or minced through a 3 mm. disc.

Two different production methods were used. In the first one, referred to as the "conventional method", the liver was chopped with 1,8 % nitrite salt till the beginning of the well-known phenomenon of buble formation. Thereafter, the hot broth was added, followed by the pre-cooked fat and the whole was chopped to a homogeneous product. Finally, the balance of nitrite salt was added.

The second method, referred to as "emulsion method", consisted of the preparation of an emulsion from the pre-cooked fat and the broth by means of sodium caseinate, to which the pre-chopped or minced liver with 1,8 % nitrite salt was added. Although time and labour consuming, the technique of pre-chopping the liver was adopted, since chopping the minced liver in a fat-water emulsion does not always result in the desired fine and homogeneous texture. Technologically more attractive is a method in which the minced or whole liver is shortly chopped into the emulsion and subsequently passed through a K.S.mill, microcutter or similar machine. However, for relatively small experimental batches, this method results in a disproportionate quantity of entrapped air in the products, which makes determination of stability and measurement of consistency unreliable. Moreover, preliminary experiments showed no essential difference in the two techniques.

The recipes chosen were based upon 15, 25 and 40 % liver. Apart from the salt (1,8 %) the balance was added as fat and broth in the proportions 15/85, 30/70, 50/50, 75/25 and 90/10. The temperature of the pre-cooked fat, broth and emulsion at the time of addition was varied from 25° to 80°C, table I,A.

The chopping time practices for the conventional method were: I. pre-chopped liver + broth; ½ minute, II. mixture I + cooked fat; 2¼ minutes, III. mixture II + balance of salt; ¾ minute. The temperature of the fat and broth at the time of addition, of the sausage mix immediately after the fat addition, table I,B and at the end of the chopping period, was measured, table I,C.

For the emulsion method, the chopping time used was: emulsion + pre-chopped liver; 1½ minutes. The temperature measurement occurred in the emulsion, table I,A, immediately after the addition of the liver, table I, B and at the end of the chopping period, table I,C.

Table I Chopping temperatures

A initial fat, water or emulsion temperature	B after liver addition	C final temperature	
25	23 - 23	25 - 26	15 % liver
50	42 - 45	40 - 42	
80	65 - 68	56 - 59	
25	21 - 23	25 - 27	25 % liver
50	40 - 42	37 - 40	
80	59 - 62	52 - 56	
25	21 - 23	26 - 28	40 % liver
50	38 - 40	37 - 39	
80	52 - 58	48 - 50	

Table II Stability areas for emulsion method (EM) and convential method (CM) for two heat treatments

initial chopping temperature	fat	85°C CM	85°C EM	115°C CM	115°C EM
25	cheek	5,8 cm^2	17,4 cm^2	3,8 cm^2	14,0 cm^2
50	cheek	7,5 "	16,0 "	5,0 "	11,8 "
80	cheek	7,2 "	13,6 "	4,8 "	11,2 "
25	flare				7,6 "
50	flare				6,6 "
80	flare				8,4 "
25	soft belly				15,0 "
50	soft belly				11,4 "
80	soft belly				9,8 "
25	cheek and frozen liver				14,8 "
50	cheek and frozen liver				13,8 "
80	cheek and frozen liver				12,6 "

The speed of the chopper bowl and blades for both methods were 26 and 3200 r.p.m., respectively.

The stuffing was performed in 125 gram cans, the subsequent heat treatment applied was 1 h. at 85°C or ¾ h. at 115°C.

After one week of rest, the cans were opened and sausage stability was determined in terms of fat and water separation, whereas consistency was measured with a penetrometer. (Sommer and Runge, Berlin).

A taste panel of 5 persons marked the products in a scale ranging from 0 (bad) to 10 (excellent) for taste, colour, texture, slicibility and spreadability.

The last three parameters were evaluated in terms of homogeneity and coherence (texture), the possibility to cut slices of 1 cm thickness (slicibility) and the performance of spreading the product with a knife on a solid surface (spreadability). In the presented curves only the scores higher than 5,5 were used.

RESULTS AND DISCUSSION

Product stability.

Experimental series with the conventional method (CM), in which fresh liver and cheek, soft belly fat and flare fat were used, revealed that only the former type of fat was acceptable in terms of taste and flavour. The two latter fat tissues caused a somewhat greasy taste and were rejected.

Experiments performed

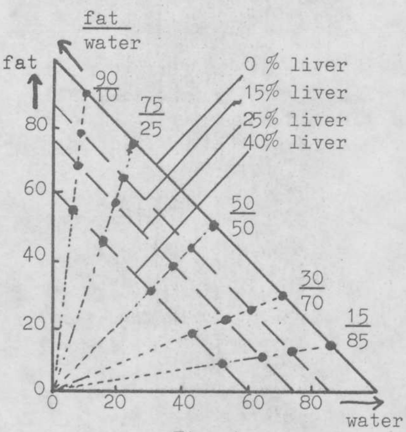


Fig. 1

Influence of the chopping temperature on produkt stability at 115°C.

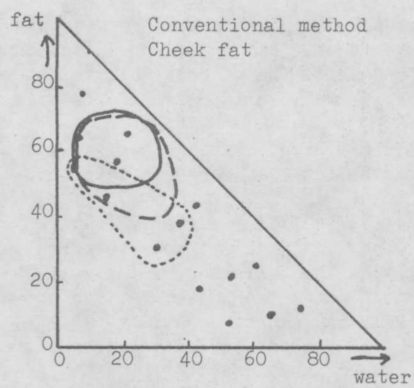


Fig. 2

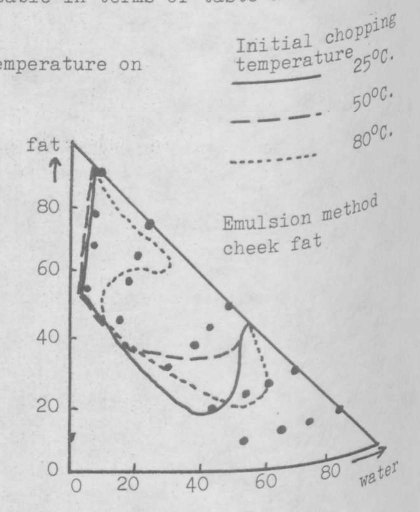
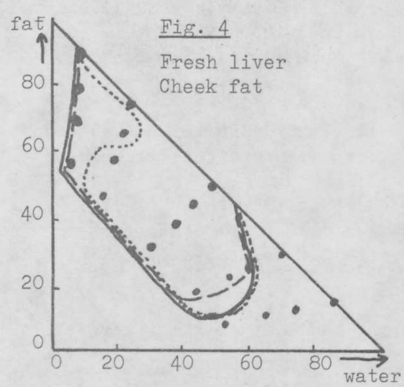
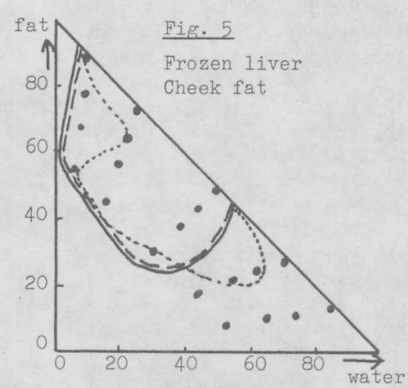
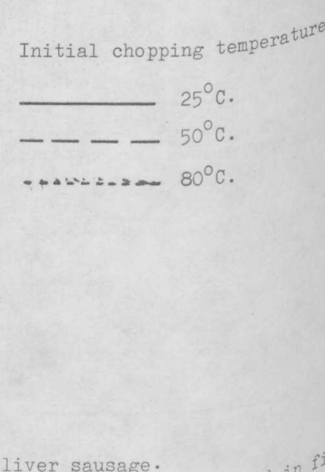


Fig. 3

Influence of the chopping temperature on product stability at 85°C.







This may be one of the reasons for the historical preference of cheek fat in liver sausage.

The ingredient proportions (recipes) which resulted in heat-stable products at 115°C are presented in fig 2.

The liver content and the fat/water proportions are indicated in fig.1.

The three loops in figure 2 show the influence of the chopping temperature on the areas of stable sausages. It can be seen that the stability area shifts to a lower fat/water ratio at increasing chopping temperature. The two other fat types mentioned (not presented in the figure) show a similar behaviour, with the exception that the fat separation appears to be higher at high fat/water proportions in the recipes, than in the case of cheek fat. This may be an other reason for the preference of cheek fat.

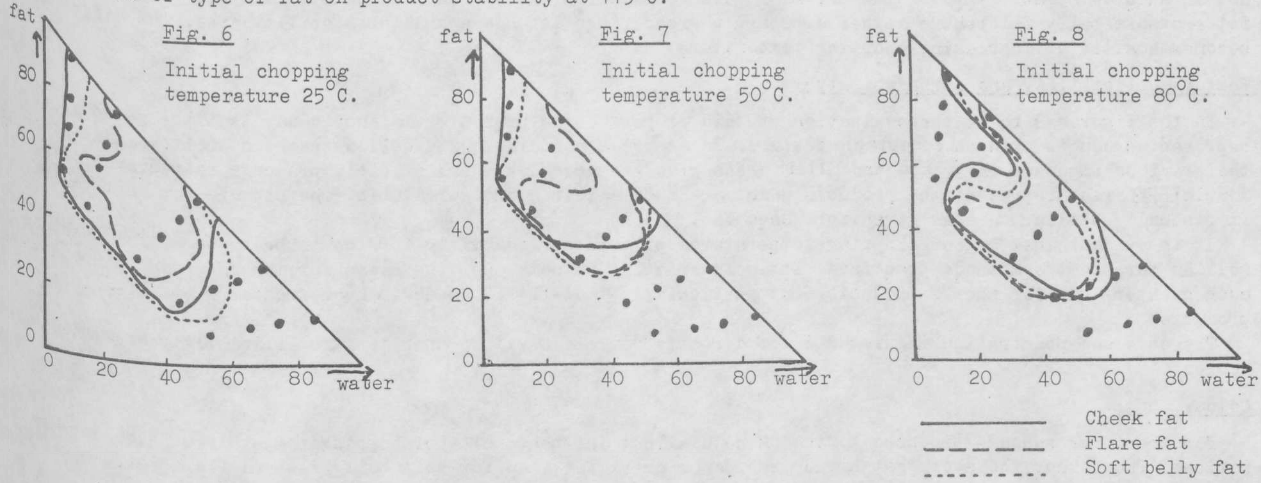
For pasteurized liver sausage (85°C) similar but some what greater loops were found.

The results of similar experiments with the emulsion method (EM), in which fresh pork liver and cheek fat were used, are given in figures 3 and 4, for heat treatments of 115°C and 85°C, respectively. As can be seen from these figures the stability areas are considerably greater for the EM than for the CM. Also here the stability loops shift to lower fat/water ratios at increasing chopping temperature. The influence of heat treatment at 85°C and 115°C on the stability areas for EM and CM respectively, is summarized in table II.

Comparison of the figures 4 and 5 shows the influence of the use of deep frozen liver.

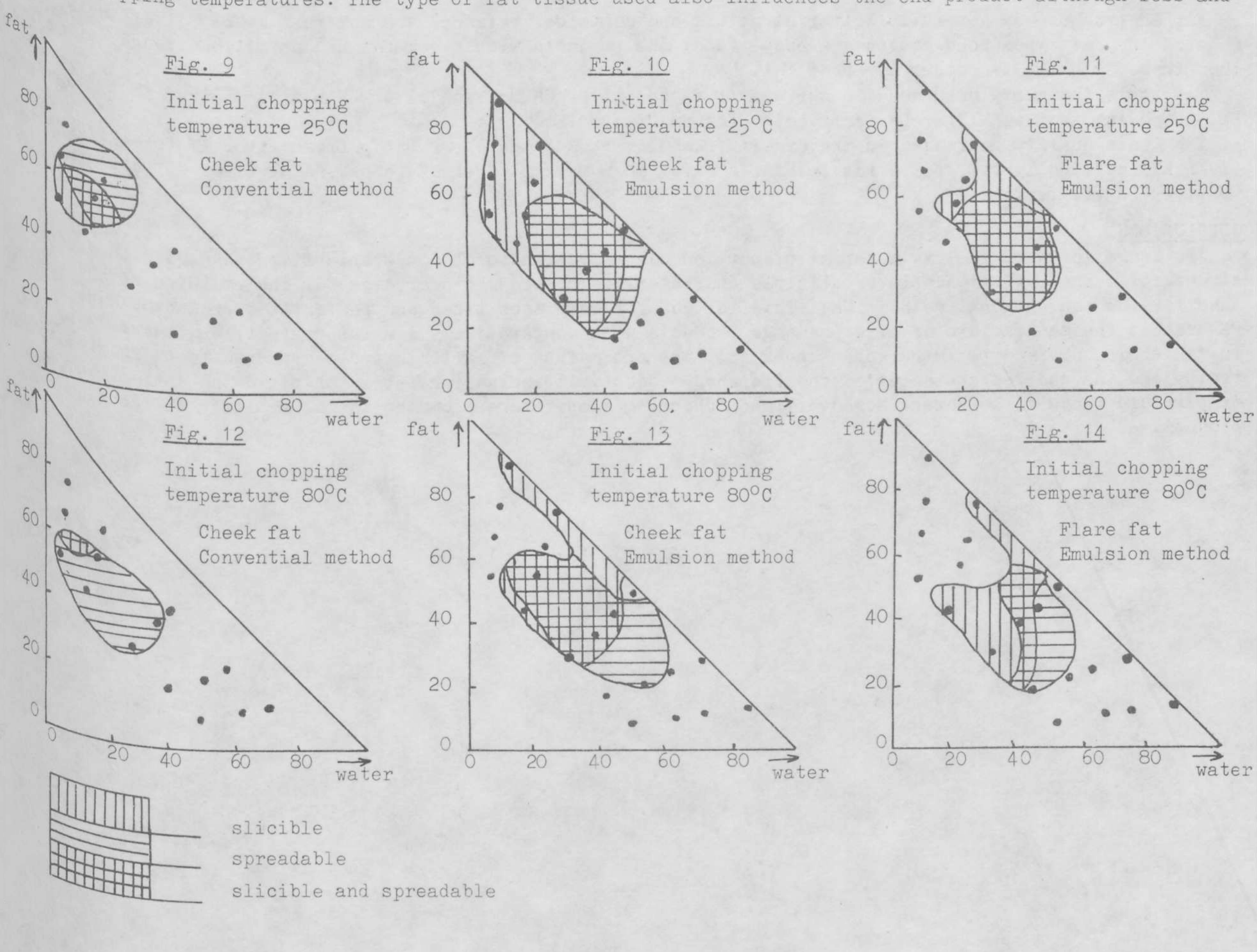
The behaviour of soft belly fat and flare fat in comparison to that of cheek fat used in the EM, is presented in the figures 6, 7 and 8. The stability areas of the liver sausage with the various fats suggest a correlation between the stability of the fat-water emulsion itself and that of the final product. On the line for liver = 0

Influence of type of fat on product stability at 115°C.



the stable areas of the pure fat-water emulsions after heat treatment can be found. Beyond the fat/water proportions indicated no stable emulsions can be formed under the conditions practised. From the figures 6, 7 and 8 it appears that at high fat/water ratios the addition of liver tends to destabilize the emulsion, probably by withdrawing water from the emulsion. This is reflected in an unstable liver sausage. The emulsions of flare fat tissue, having the lowest natural water content (approximately 6 %) suffer most, followed by those made of soft belly fat (own water content approximately 15 %) and cheek fat (own water content approximately 25 %). This effect seems to be more severe at high chopping temperatures and results in fat separation, so decreasing the stability area.

At lower fat/water proportions the inverse appears to occur. Heat-unstable fat-water emulsions turn to stable systems when liver is added, so increasing the stability area. The effect observed is noticable at low chopping temperatures (25°C), less evident at medium chopping temperatures (50°C) and very clear at high chopping temperatures (80°C). This phenomenon may indicate that increased chopping temperatures have no effect or even a slightly unfavourable influence until a beginning of coagulation of the liver takes place. Also the amount of liver effects the stability of the final product; this influence, however, is mainly noticable for products made at higher chopping temperatures. The type of fat tissue used also influences the end product although less and



not in an unfavourable way for the EM, as it does for the CM. As far as product stability is concerned, cheek fat and soft belly fat behave rather similar, whereas flare fat has a smaller stability area. The difference becomes smaller at increasing chopping temperature.

Texture, slicibility and spreadability.

In the figures 9 to 14 the evaluation of said properties is presented in such a way that the given areas represent products with an acceptable texture. These areas coincide quite well with the stability areas given in the previous figures. The ≡≡≡ and ||||||| areas give the spreadable and slicible products respectively. The double ╪╪╪ areas represent the products which are both slicible and spreadable. The picture for soft belly fat is basically similar to that given for cheek fat.

It is evident that higher chopping temperatures promote spreadability for the three types of fat used, as well as for the two methods practised. It is interesting to note that the areas for the EM-products are not only much greater than for the CM-products, but particularly that the EM leads to much greater areas of slicible products.

The obtained penetration figures did not directly correlate with either texture, slicibility or spreadability scores.

Colour.

For the liver sausage produced by the CM no distinct influence of the chopping temperature on colour has been noticed. The colour, however, got higher scoresfor cheek fat than for soft belly fat and flare fat, as well as for a higher liver percentage.

The sausage produced by the EM generally showed a little less strong colour, but the various types of fat tissue hardly influenced the colour, neither did the chopping temperature. Also between fresh and frozen liver no distinct difference in colour was noticed. At higher fat/water ratios the colour became less pronounced. Also here an increased amount of liver was reflected in a stronger colour, although the influence was less than for CM products. The sterilized products had a little stronger colour, with a shade of brown, than the pasteurized items. This difference, however, was smaller for the EM-products than for the CM-products.

Taste.

Generally, a stronger taste was achieved with increasing amounts of liver. At a fixed liver concentration the taste itself was not strongly affected by the fat/water ratio, although a richer taste was observed for the higher fat/water proportions. Besides the liver taste itself a great influence of the mouthfeel and the product structure on the general taste impression was observed. The taste in a broader sense was generally speaking more acceptable, when structure and mouthfeel had higher scores.

For CM-products the use of cheek fat was greatly preferred over that of soft belly fat and flare fat, which gave the product a greasy taste. The area of products with acceptable structure and mouthfeel was comparatively small.

For EM-products, a generally better structure and mouthfeel balanced the somewhat weaker liver taste. However, none of the fat types used caused a greasy taste; the products with cheek fat had a little stronger liver taste than those with the two other types of fat.

The taste intensity decreased in the order: frozen liver CM > fresh liver CM > frozen liver EM > fresh liver EM (cheek fat) > fresh liver EM (soft belly fat and flare fat).

The taste quality decreased in the order: fresh liver CM (high cheek fat) ≥ fresh liver EM (cheek fat) ≥ fresh liver EM (soft belly fat, flare fat) ≥ frozen liver EM > frozen liver CM (cheek fat) ≫ liver CM (soft belly fat) > liver CM (flare fat).

CONCLUSIONS

The range in which the raw material proportion can be varied to obtain stable liver sausage with acceptable structure, either of spreadable or slicible character, is considerable greater for the emulsion method (EM), than for the conventional method (CM). This is true for both sterilized and pasteurized products. Moreover, the EM enables the manufacture of liver sausage products with comparatively low fat content, and leaves more freedom in the choice of fat types other than cheek fat. The optimal chopping temperature appeared to be related to the recipe and the desired character of the finished product. At increasing fat/water ratio the optimal chopping temperature tends to be lower. Moreover, lower chopping temperature promotes the slicibility of the finished product.