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INFLUENCE OF STORAGE OF PORK AND BEEF FAT TISSUE ON THE STABILITY AND DISPERSION OF EMULSIONS

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INFLUENCE OF STORAGE OF PORK AND BEEF FAT TISSUE ON THE STABILITY AND DISPERSION OF EMULSIONS

The meat processing - as the basic field in meat technology has been making a tremendous progress for the past twenty years. Many, until recently unknown and in their nature complex problems in the biochemistry of postmortem meat changes have been cleared, many changes and reactions pertaining to the curing, smoking and the influence of various ingredients have been analysed, an extraordinary progress has been achieved esp. in the development of various machines, instruments and equipment in general. In this connection it has become quite possible and for a long time a necessity to learn more about the essence and the factors causing the appearance of the characteristic microstructure and macrostructure of meat materials in the processing of frankfurters and similar products. A particularly important field in this respect is the homogenization of still warm meat with other ingredients (a technique which, though more and more neglected now, is nevertheless, giving high quality products).

Within the framework of these problems a very important place occupies the question of emulsions of fats in water, or in semiliquid desintegrated and homogenated

mixture of muscle, connective and fat tissues and additional ingredients. There is no doubt that a well made homogenous content of frankfurters or similar products, is in fact a hetero enous complex of coloidal, fat and other dispersion systems, as well as of suspensions in solutions of various ingredients and concentrations. The effect of one system are increased by or interfered with those of the others to a considerable extent. Therefore, though the obtaining and maintainance of fine dispersibility and homogenity of microstructures of the frankfurters and other sausages should be primarily observed within the problem as a whole, the analysis of factors causing these properties in separated models makes an important integral part of the routine work.

In the past years, in the field of investigation on animal fat emulsions and on factors influencing their properties there has been quite a number of important reports, like those by Hegarty and associates (6), Swift and Lockett (22), Swift and Sulzbacher (23) and others. This paper - being a part of a larger study we have been working for years, has been inspired in part by the mentioned authors.

Material and Methods

1. Research materials: We egzamined fat tissues from four different regions of pork carcass: jowl (fat tissue of regiae parotidica, coli ventralis and laryngea); back fat (fat tissue of regiae dorsalis and lumbalis); belly part (fat tissue of regiae lumbalis and mesograstrica) and leaf (subpertitoneal fat tissues) as well as two regions of beef carcass: kidney region (subperitoneal fat tissues) and that subcuteanous (fat tissues of regia femoralis media). Fat

tissues were taken immediately after slaughtering.

Prior to examinations, the fat tissues were stored at room temperature (18° - 22°C) or in refrigerator (plus 4°C).

Free fatty acid values were determined in the melted fat tissues (at 60°C for one hour) immediately after slaughtering and during the storage period immediately betore the emulsification. The acide titration was carried out by NaOH (AOCS - Official Method (Ca-5a-40).

2. Emulsifying agent: as emulsifying agents were used preparations "Tari" (Guilini GmbH, Ludwigshafen) and "Gervita" (Gervais AG, Rosenheim). The composition of these preparations have been patented. The basic active component to the "Tari" preparation are poliphosphates and to the "Gervita" preparation milk proteins.

3. Preparation of fat tissues for emulsification procedure.- After storage at room temperature from two hours up to four days (two hours up to twenty days in refrigerators), 100 g each of fat tissues from various pig and bull regions were taken and ground with the meat grinder through plate (5 mm). The ground fat tissues were than put into cans of 150 g (73 mm diametre) and heated in water bath for one hour at 60°C. Immediately after this temperature was reached, the contents were transfered into the emulgator.

4. Emulsions: these were made in the following way: into mixer with propelling device ("Atomix", MSE-London) 100 g of fat tissue was put (heated up to 60°C), added 2 g "Tari" or 10 g "Gervita" preparation and, finally, after a very short period of homogenization 100 ml of water (60°C) was added. In all cases the emulsification period did not last more than 30 seconds at 12.000 rpm which means that all these ingredients were stirred 6.000 times in 30 seconds.

5. Examination of emulsion properties.- In all emulsions both the dispersion and the stability (before and after heating) were determined.

The stability before heating was determined in the way that emulsions obtained were put immediately after they were made into graduated glass cylinders which were filled up to 100 ml. In intervals of 2, 12 and 24 hours the breaking of emulsions was observed. The examinations were carried out at room temperature.

The stability after heating was determined in the following way: emulsions were put into cans of 150 g each (73 mm in diametre) and heated at 114°C/30 min. (Temperature raise and cooling down had lasted for 15 minutes each). Thereafter, the emulsions were transfered into graduated glass cylinder and the quality of separated water was determined after 2, 12, and 24 hours at room temperature.

The dispersion of emulsions was determined as follows: a drop of emulsion was put into micro-slide, spread over, airdried

and the diametre of fat dorplets determined microscopically. Measuring consisted in observations in 3o visible fields and calculating the average.

Our own investigation

The objective of our research work was set up to find out whether and to what extent the fat tissue originating from various anatomic regions of hogs i.e. of cattle may influence the quality and durability of emulsions obtained by means of poliphosphate ("Tari") and protein ("Gervita") preparations. The second objective was to provide an answer to the question of how these emulsions are being ingluenced by preliminary storage of fat tissues viz.by their free fat acid values (FFA-values). To present a survey as clear as possible, we classify our results into two sections.

1. Influence of different hog fat portions and of their storage at various temperatures on the dispersions and the stability of emulsions.- From the results shown in Tables 1 and 2 we may see that finest emulsions, i.e. highest dispersity of fatty globules - under the same conditions - are provided by leaf fat (globula diametre from 6 - 15 microns), middle fine is the emulsion dispersion provided by jowl and back fat (from 14 - 21 microns) whilst largest globula (from 17 - 44 microns in diametre) were found in belly fat emulsions, if poliphosphates were use as emulgators.

In emulsions made by means of proteins this relationship remains almost the same but the absolute values

of diametres in fatty globula are considerably decreased.

Out of data contained in fig. 1, one may not draw the conclusion that there are differences in stability of emulsions of fats of any anatomical portion, provided the emulgating reaction is carried out by poliphosphates. Small differences have been noticed especially with regard to thermostability of all regional fatty tissues examined. On the other hand if fatty tissues from various pork regia are emulgated by proteins, very stable emulsions will be obtained in all cases, both prior to and after heating cyclus.

As for the influence of the duration and temperature of fat tissue storage, i.e. of free fat acid values (Fig.3) on emulsion dispersion (Tables 1 and 2), it is clear that the globula diametre of dispersed fats is decreasing with the storage duration, i.e. through increasing the FFA - value, quite irrespective of the kind of emulgator used. As for the influence of FFA-value on stability especially on thermostability of poliphosphate emulsions one may conclude that it improves, generally taken, with the increase of FFA-value. This is specially the case when this value exceedes 2.

Influence of different beef fat portions and their storage at various temperatures on the dispersion and stability of emulsions.- Results in Tables 3 and 4 show that in generally there is no difference in globula sizes in emulsions obtained from subcutaneous fat and that from kidney fat. Slight differences are present, however, only in diametres

of globula in tallow emulsions made by means of "Gervita" and those made by means of "Tari" preparation. No differences may, on the other hand, be established with regard to the stability of emulsions from kidney fat and those from the subcutaneous fat (Fig.2).

Duration and temperature of storage affecting the FFA-value do influence emulgation of fat in the way that by increasing the FFA-value they increase the dispersion of emulsions, irrespective of the anatomic origin of fat and of the emulgator used. Stability rates of emulsions from both regia examined may also be increased by raising the FFA-value especially when it exceeds 1.5 (Fig.2 and 4).

x

x x

Whilst the differences in sizes of globula of fats from various anatomic regions of pigs may, in the essence, be explained by differences in chemical compounds and consequently in physical properties, the explenation of the influence of storage i.e. of the FFA-value on the dispersion and the stability of emulsions of pork and bovine fat emulsions should in the first place be sought for in effects that the free fat acids develop as emulgators. The phenomenon of formation of films of mixed emulsifiers (in our series fat acids and poliphosphated viz. proteins) has been explained by Schulman and Cockbein (2,2o). This complex reaction resulting in formation of films should take place at the iterface and

the resulting interfacial film should offer greater strength and resistance to rupture.

It should be emphasized that no doubt there are differences between the pork and bovine fat tissue emulsions. Fatty tissue do not represent chemicaly pure fat and therefore in addition to emulsions there are also suspensions (relatively solid structural parts: remnants of the connective and other tissues which, during the emulgating procedure, are being desintegrated into small particles and dispersed by rotation) as well as coloidal or semicoloidal solutions (hydrated colagen molecules). In short, complex dispersion system are involved, the basis and the most important part of which are fat emulsions.

x

x x

From the results obtained we might draw the following conclusions:

1. There are considerable differences in dispersing but not in the stability of emulsions of fat tissue originating from various anatomic regiae of pigs: highest dispersion rate is shown by leaf fat, medium rate by the jowl and back fat, whilst rather large globulae have been found in belly emulsions(by phosphates as emulgators).

Through the increase of the FFA-values (especially over 2) the dispersion and the stability of all pork fats emulsions will likewise be increased.

2. No differences in the size of globulae have been found, nor in the stability of emulsions of subcutaneous or kidney bovine fat. Globulae in emulsions, made by means of poliphosphates, are permanently a little smaller in size than those in emulsions obtained by "Gervita" preparation.

The dispersion and stability rates increase with the increase of FFA-value, especially over 1.5.

3. Whilst the differences in size of globulae of various pork regional fats may be explained by the differences in chemical and physical properties, the influence of the increase of acid value on the dispersion and stability of emulsions is the function of the free fat acids, which together with the emulgator (poliphosphate or protein) provide for interfacial films of the greatest strength and resistance to rupture.

4. Emulsions of fat tissues, unlike emulsions of chemical fats, do not represent simple but complex dispersion systems, the integral part of which are also suspensions and, to some smaller extent, coloidal or semicoloidal solutions as well.

INFLUENCE OF STORAGE OF PORK AND BEEF FAT TISSUE ON THE STABILITY AND DISPERSION OF EMULSIONS

Summary

The objective in our series has been to find out whether and to what extent the fat tissues originating from various anatomic regions of pork i.e. of beef may influence the quality and the stability of emulsions obtained by means of poliphosphate ("Tari") and protein ("Gervita") preparations. The following objective was to provide an answer to the question of how these emulsions are being influenced by preliminary storage of fat tissues viz. by their FFA-values.

From the results obtained we might draw the following conclusions:

1. There are considerable differences in dispersing but not in the stability of emulsions of fat tissues originating from various anatomic regiae of pigs: highest dispersion rate is shown by the leaf fat, medium rate by the jowl and back fat whilst rather large globulae have been found in belly emulsions (by phosphates as emulgators).

Through the increase of the FFA-value (especially over 2- the dispersion and the stability of oll pork fats emulsions will likewise be increased.

2. No differences in size of globulae have been found, nor in the stability of emulsions of the subcutaneous

kidney bovine fat. Globulae in emulsions, made for by means of poliphosphates, are permanently a little smaller in size than those in emulsions obtained by "Gervita" preparation.

The dispersion and stability rates increase with the increase of FFA-value, especially over 1.5.

3. Whilst the difference in size of globulae of various pork regional fats may be explained by the difference in chemical and physical properties, the influence of the increase of acid value on the dispersion and stability of emulsions is the function of the free fat acids, which together with the additional emulgator (poliphosphate or protein) provide for interfacial films of the greatest strength and resistance to rupture.

4. Emulsions of fat tissues, unlike emulsions of chamical fats, do not represent simple but complex dispersion systems, the integral part of which are also suspencions and, to some extent, the coloidal or semicoloidal solutions as well.

ВЛИЯНЫЕ УСЛОВИЙ ХРАНЕНИЯ ЖИРОСЫРЬЯ СВИНЕЙ И РОГАТОГО СКОТА НА СТАБИЛЬНОСТЬ И СТЕПЕНЬ ДИСПЕРСНОСТИ ЖИРА

Резюме

Целью исследований было установление в какой мере жиросырье разных частей туш свиней и крупного рогатого скота оказывает влияние на стабильность и дисперсность эмульсий полученых при помощи полифосфатных /"Тари"/ и белковых препаратов /"Гервита"/. Кроме того надо было ответить на вопрос как на упомянутые эмульсии действует изменение градуса кислотности жиросырья в период хранения.

Полученные результаты позволяют сделать следующие выводы:

I. Значительная разница существует в степени дисперсности, но не и в стабильности эмульсий жиросырья разных частей свинных туш; высокую дисперсность имеет околопочечный жир, среднюю дисперсность показывает жиросырье подбородка и спинной части, а сравнительно крупные жирные частицы находим в эмульсиях жиросырья брюшной части с применением полифосфата в качестве эмульгатора.

С возрастанием градуса кислотности, особенно после 2°, повышаются дисперсность и постоянность эмульсий всех частьей жиросырья свинных туш.

2. Разници в размерах глобулов нет, также как ни в постоянности эмульсий подкожного и околопочечного жиросырья рогато-

го скота. Жировые частицы в эмульсиях, полученные при помощи полифосфатов, постоянно бывают более мелким чем в эмульсиях получаемых с применением "Гергита".

Дисперсность и постоянность эмульсий повышаются с возрастанием градуса кислотности говяжьего жира, особенно после $4,5^{\circ}$.

3. Разницу в степени дисперсности свиных жиров можно объяснить химическими и физическими особенностями, в то время как влияние увеличения градуса кислотности на степень дисперсности и стабильности эмульсий объясняется накоплением жирных кислот, которые вместе с эмульгатором /полифосфатом и белками/ дают межповерхностный устойчивый фильм.

4. Эмульсии жиросырья, в отличие от эмульсий чистого жира, не являются простой, а наоборот, сложной дисперсной системой, составную часть которой представляют суспензии и, в меньшей степени коллоидные растворы.

EINFLUSS DER LAGERUNGSBEDINGUNGEN DES FETTGEWEBES DER SCHWEINE UND DER RINDER AUF DIE STABILITÄT UND DISPERSIONSGRAP DER EMULSIONEN

Zusammenfassung

Die Aufgabe der Arbeit war festzustellen ob und in welchem Masse das Fettgewebe der anatomisch verschiedenen Teile der Schweine und Rinderfettgewebe den Einfluss auf die Qualität und Stabilität der Emulsionen haben, die mittels Polyphosphat ("Tari") oder Eiweisstoff-Präparaten ("Gervita") aus der zerkleinerten fettgewebigen Masse hergestellt sind. Die zweite Aufgabe war, die Antwort auf dic Frage zu geben, wie auf die erwähnten Emulsionen die Vorlagerung des Fettgewebes, d.h.dessen Säuregrad wirkt.

Die ergebenen Resultate erlauben die folgenden Schlüsse:

1. Es bestehen erhebliche Feinstverteilungsdifferenzen, aber keine Unterschiede in Stabilität der Emulsionen der Fettgewebe, welche aus verschiedenen anatomischen Regionen der Schweine herstammen; die beste Feinstverteilung zeigen die Fettkugeln des Nierenfettgewebes, mittelmässig zerteilt sich Unterkinn-und Rückenspeck und schliesslich ziemlich grobe Fetttröpfchen findet man in Emulsionen des Bauchspecks (mit Polyphosphaten als Emulgator).

Mit Steigerung des Säuregrades besonders über

2 - steigt die Feinstverteilung und Stabilität der Emulsionen der verschiedenen Fettgewebe des Schweinekörpers.

2. Es bestehen Keine Feinstverteilung-und keine Stabilitätunterschiede des Unterhaut-und Nierenfettgewebes des Rindes. Die Fett-Tröpfchen mit Polyphosphaten hergestellten Emulsionen sind etwas feiner als in Emulsionen hergestellten mit "Gervita",

Die Feinstverteilung und Stabilität der Emulsionen steigen mit dem Säuregrad des Talges (besonders über 1,5).

3. Während die Unterschiede in der Grösse der Tröpfchen verschiedener Schweinefette als Unterschiede in chemisch-physikalichen Eigenschaften zu erklären sind, ist der Einfluss der Steigerung des Säuregrades auf den Feinsverteilungsgrad und Stabilität der Emulsionen, die mit Emulgator (Polyphosphate oder Eiweisstoff) einen stabilen oberflächlichen Film bilden, zuzuschreiben.

4. Fettgewebeemulsionen zum Unterschied von Fetteemulsionen, stellen nicht einfache sondern zusammengesetzte Dispersionssysteme dar, deren Bestandeinheiten auch Suspensionen, einigermassen aber auch die Kolloidlösungen einschliessen.

Wie wurde die Stabilität bestimmt? Mathilde

INFLUENCE OF STORAGE TEMPERATURE OF FATTY TISSUE DERIVED FROM DIFFERENT PARTS OF PORK ON DISPERSION OF EMULSIONS OBTAINED BY "TARI"

Table 1.

days of storage	diameter (μ) of fat globules in emulsion of							
	jowl fatty tissue		leaf fatty tissue		back fatty tissue		belly fatty tissue	
	+20°C	+4°C	+20°C	+4°C	+20°C	+4°C	+20°C	+4°C
0	21	21	15	15	20	20	44	44
1	23	35	21	16	23	32	42	40
2	28	37	10	13	24	55	40	37
3	19	51	9	10	25	20	40	36
4		18	8	8	17	20	24	32
5		30		7		18		28
10		22		6		14		22
20		14		6		14		17

INFLUENCE OF STORAGE TEMPERATURE OF FATTY TISSUE DERIVED FROM DIFFERENT PARTS OF PORK ON DISPERSION OF EMULSIONS OBTAINED BY "GERVITA"

Table 2.

days of storage	diameter (μ) of fat globules in emulsions of							
	jowl fatty tissue		leaf fatty tissue		back fatty tissue		belly fatty tissue	
	+20°C	+4°C	+20°C	+4°C	+20°C	+4°C	+20°C	+4°C
0	15	15	10	10	26	26	26	26
1	20	22	16	15	24	22	32	32
2	21	16	14	18	21	17	16	14
3	14	16	12	11	20	17	15	13
4	12	16	9	11	12	15	12	13
5		16		11		14		13
10		15		10		13		12
20		12		7		12		11

INFLUENCE OF STORAGE TEMPERATURE OF FATTY TISSUE DERIVED FROM DIFFERENT PARTS OF BEEF ON DISPERSION OF EMULSIONS OBTAINED BY "TARI"

Table 3.

days of storage	diameter (μ) of fat globules in emulsions of			
	kidney fat		subcutaneous fat	
	+20°C	+4°C	+20°C	+4°C
0	16	16	15	15
1	10	13	10	16
2	10	13	10	15
3	9	12	9	13
4	7	11	7	12
5		9		11
10		7		8
20		7		7

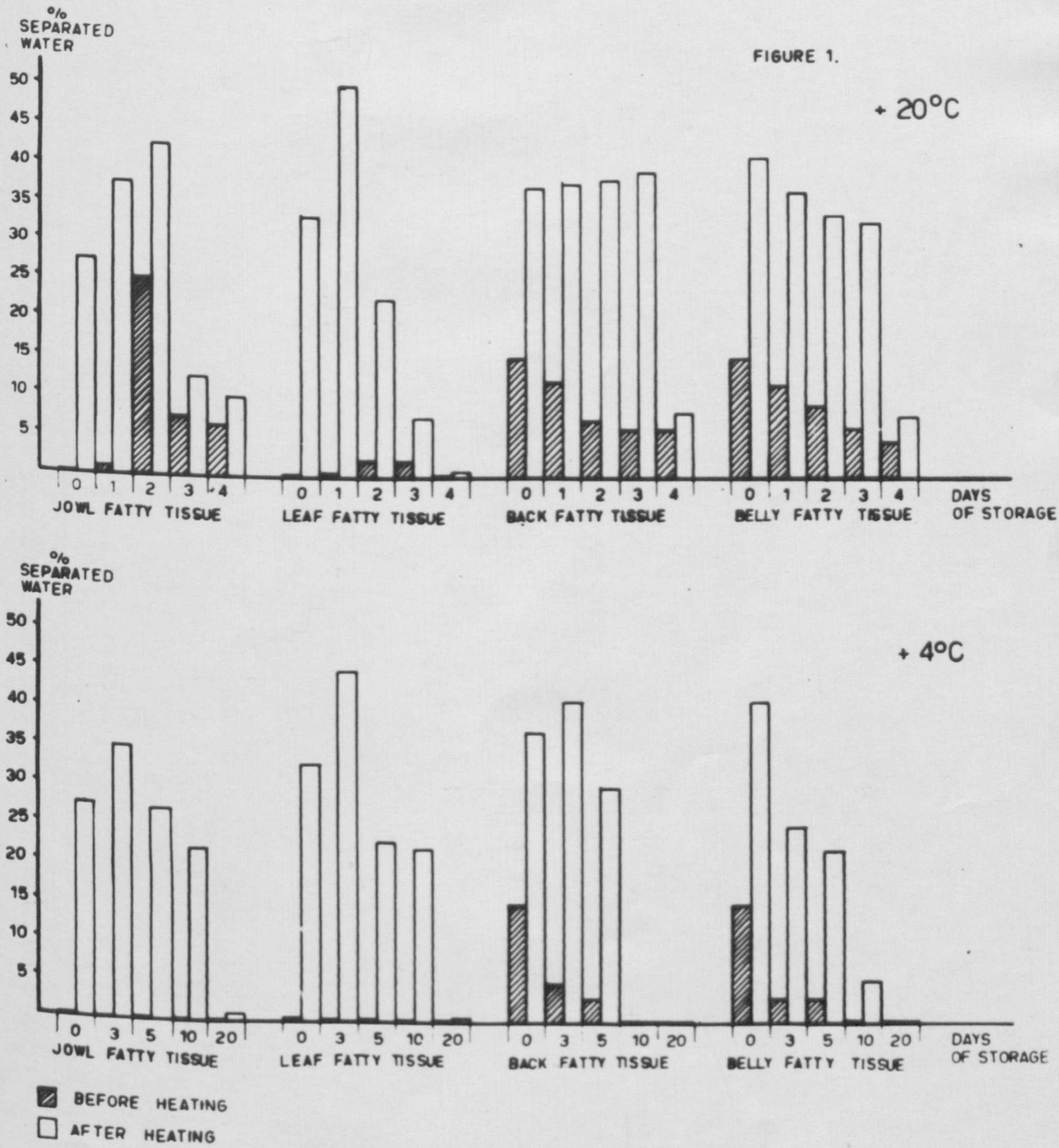
INFLUENCE OF STORAGE TEMPERATURE OF FATTY TISSUE DERIVED FROM DIFFERENT PARTS OF BEEF ON DISPERSION OF EMULSIONS OBTAINED BY "GERVITA"

Table 4.

days of storage	diameter (μ) of fat globules in emulsions of			
	kidney fat		subcutaneous fat	
	+20°C	+4°C	+20°C	+4°C
0	18	18	22	22
1	18	16	22	22
2	15	16	16	21
3	9	16	9	16
4	9	16	9	16
5		15		14
10		14		8
20		14		7

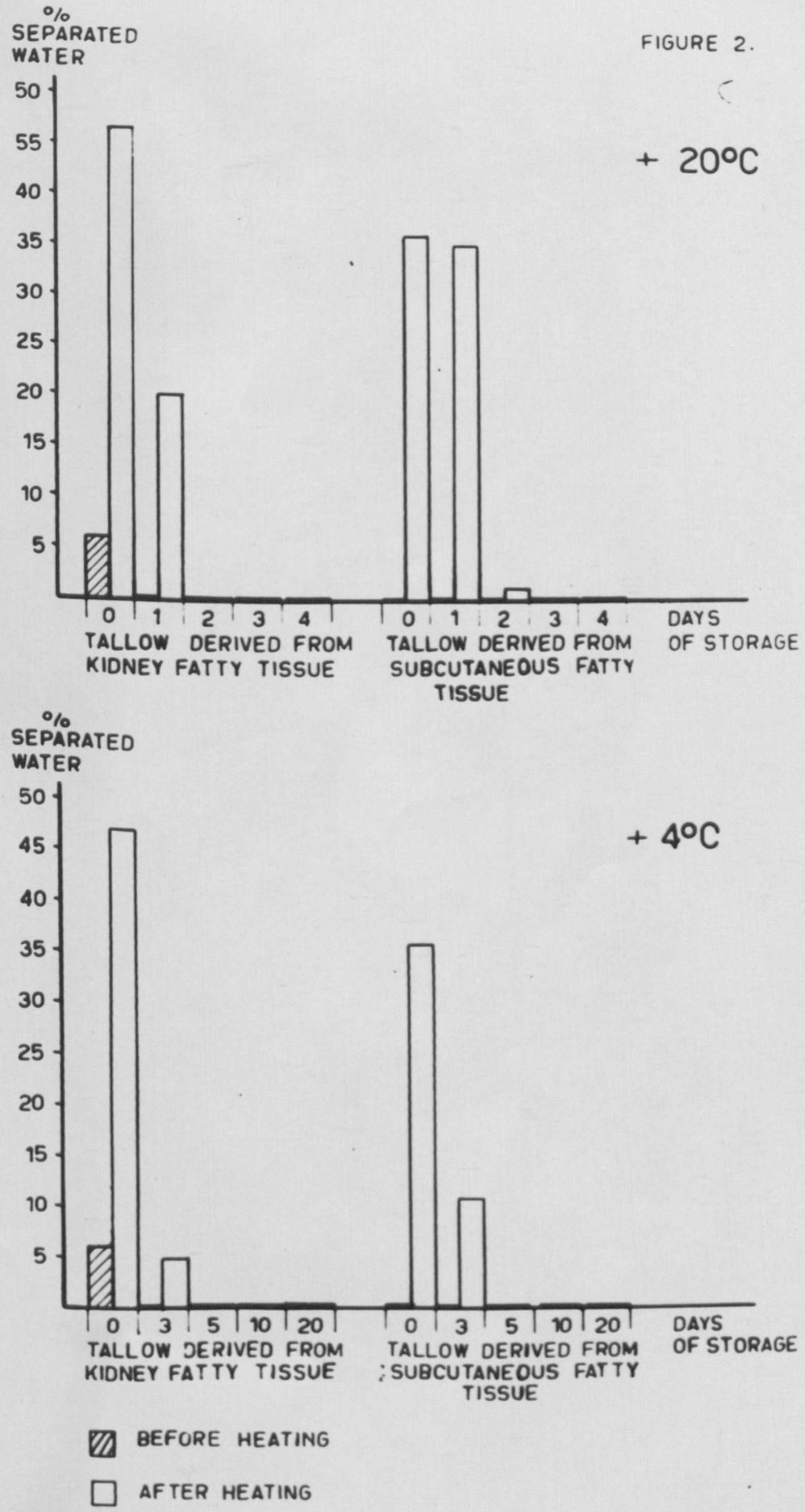
INFLUENCE OF STORAGE TEMPERATURE OF FATTY TISSUE DERIVED FROM DIFFERENT PARTS OF PORK ON THE STABILITY OF EMULSIONS OBTAINED BY „TARI"

FIGURE 1.



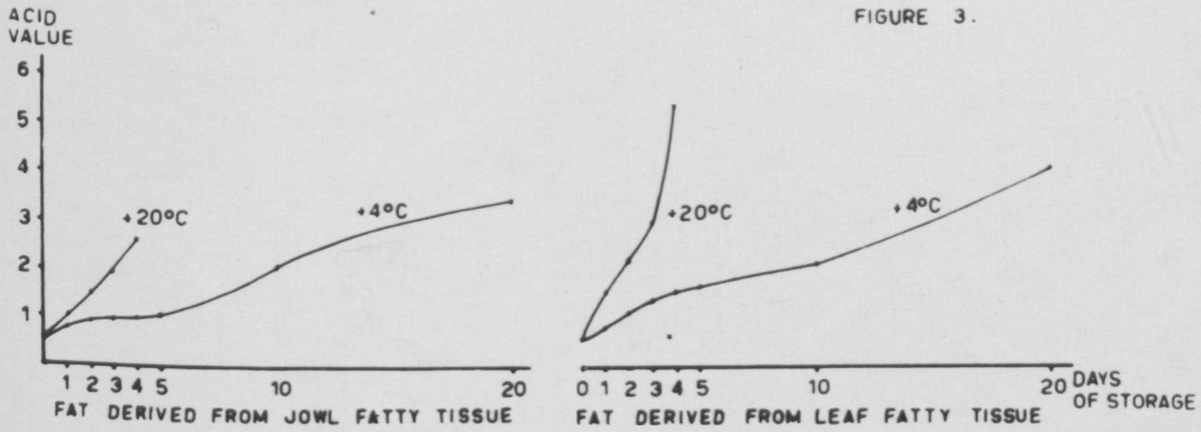
INFLUENCE OF STORAGE TEMPERATURE OF FATTY TISSUE DERIVED FROM DIFFERENT PARTS OF BEEF ON THE STABILITY OF EMULSIONS OBTAINED BY „TARI"

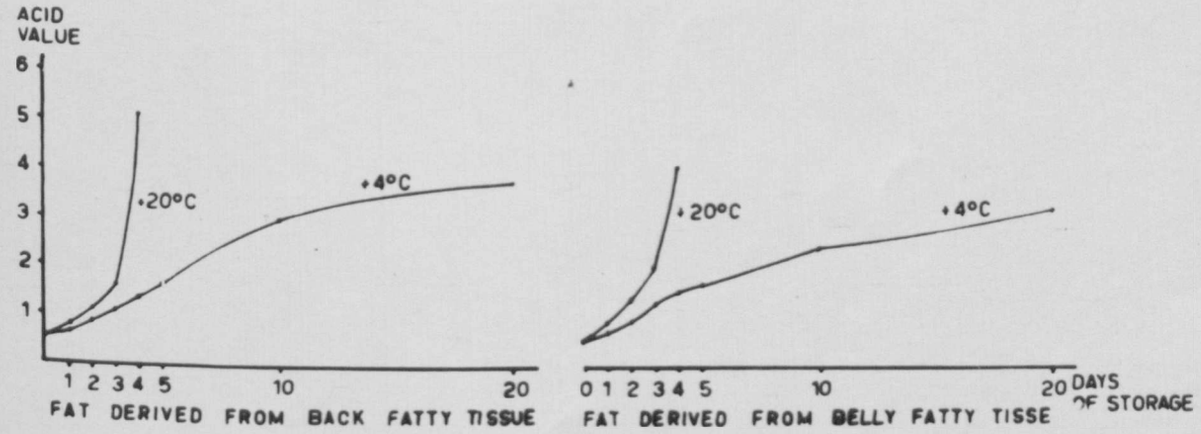
FIGURE 2.



INFLUENCE OF STORAGE TEMPERATURE OF FATTY TISSUE DERIVED FROM DIFFERENT PARTS OF PORK ON THE ACID VALUE OF FAT

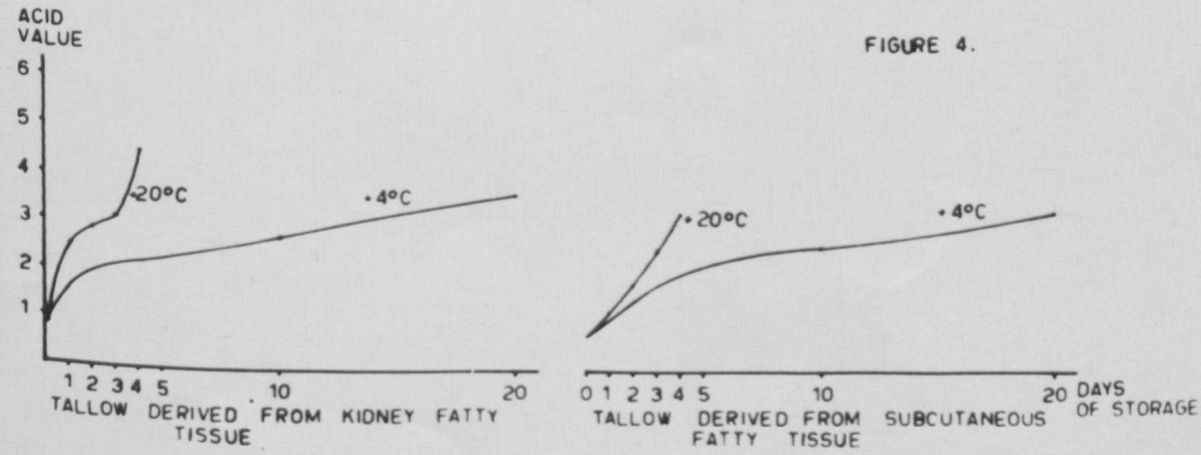
FIGURE 3.





INFLUENCE OF STORAGE TEMPERATURE OF FATTY TISSUE DERIVED FROM DIFFERENT PARTS OF BEEF ON THE ACID VALUE OF TALLOW

FIGURE 4.



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