Analysis of some bio-active components of pig's blood

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The quality of the meat and meat products depends much on the physiological condition of the animals. Several test data conform the supposed relationship between the concentration level of certain bio-active blood components and the post mortem processes in meat and adipose tissue. Thereby analysis of blood components may yield valuable information of expected changes affecting quality, storage and processing.
Our experimental research work involved the study of the tocopherol level in the blood plasma of about 300 pigs. Samples originated partly from test animals fed on fodder of various compositions, and partly, from animals immediately before slaughtering.

Beside tocopherol content, also vitamin A and cholosterol contents were examined by fluorometric methods. Test results demonstrate rather important differences first of all between tocopherol levels in pig blood. These are likely to be attributed primarily to fodder composition /natural and artificial antioxidant content, proportion of unsaturated fatty acids, presence of antioxidant transformation products etc./.

Preliminary test results indicate a relationship between the tocopherol level of the blood plasma and the changes of the adipose tissue during post mortem storage and during processing.

Untersuchung einiger bio-aktiver Komponente von Schweinsblut

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Die Qualität des Fleisches und der Fleischwaren hängt stark vom physiologischen Zustand der Schlachttiere ab. Mehrere Versuchsdaten unterstützen die Annahme von Zusammenhängen zwischen der Konzentration einiger bio-aktiven Komponenten im Blut und den post-mortem--Vorgängen im Fleisch und in den Fettgeweben. Damit ergibt die Untersuchung einiger Blutkomponenten wertwolle Information über die zu erwartenden Veränderungen in Zusammenhang mit der Qualität, der Lagerung oder der Verarbeitung. Im Rahmen der Versuchs- und Forschungsarbeit wurde der Tocopherolgehalt im Blutplasma von etwa 300 Schweinen untersucht. Die Blut Proben stammten teils aus mit verschieden zusammengesetztem Futter gefütterten Versuchstiere, teils aus Tiere unmittelbar vor Abschlachtung.
Neben dem Tocopherolgehalt wurde auch der gehalt Vitamin A- und Cholesterin untersucht /alle drei durch Fluorometrie/. Aus den Versuchsergebnissen geht es hervor, dass erhebliche unterschiede im Tocopherolgehalt der einzelnen Schweine ist. Diese Unterschiede lassen sich erstens auf die Futterzusammensetzung /natürlicher und künstlicher Antioxidantgehalt, Verhältnis der ungesättigten Fettsäuren, Vorhandensein von Reaktions produkten der Antioxidaten etc./ zurückführen.

Die Ergebnisse unserer Vorversuche weisen auf einen Zusammenhang zwischen dem Tocopherolniveau im Blutplasma und den Veränderungen der Fettgewebe während der post mortem Lagerung und der Verarbeitung.

4.8

Examen de quelques composants bioactifs du sang porcine

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La qualité de la viande et des produits de charcuterie dépend considérablement de l'état physiologique des animaux de boucherie, ce sont plusieurs données experimentales qui appuient cette hypothése, qu'il'y ont des corrélations entre les teneurs en composants bioactifs du sang et les processus chimique, qui se déroulent post mortem dans la viande et les tissus adipeux,c'est pourquoi l'examen de quelques composants du sang peut fournir des informations de valeur concernant des changements prévisibles relatifs á la qualité ou au stockage.

Dans le cadre de la recherche la teneur en tocophérol de échantillons de sang porcine etait examinée. Les échantillons provenaient d'une part des animaux experimentaus de boucherie avant l'abattage. A coté de la teneur en tocophérol la teneur en vitamine A et en cholesterol était aussi déterminé par voie fluorométrique.

Sur la base des examens chimiques on constate que des differences appréciables existent dans la teneur en tocophérol du sang des porc differents, en conséquence de la composition différente des fourrages /teneur en antioxidant naturel ou synthétique; proportion des acides gras insaturés, produits transformé des antioxidants, etc./.

Les données des expériments préliminaire indiquent qu'une corrélation existe entre la teneur en tocophérole du sang et les changements qui se déroulent dans les tissus adipeux post mortem pendant la stockage et la préparation.

Исследование некоторых биологически активных компонентов свиной крови

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Качество мяса убойного скота, а также изготовляемых из него продуктов в значительной мере зависит от физиологического состояния скота, обрабатываемого в скотобойне. Ряд опытных данных подтверждает предположение, что имеются взаимосвязи между степенью концентрации некоторых биологически активных компонентов крови, а также процессами, происходящими "post mortem" в мясной и жировой тканях. Таким образом, исследование некоторых компонентов крови может дать ценные информации о качестве, а также об изменениях, связанных с хранением и обработкой.

В рамках опытно-исследовательской работы было изучено содержание токоферола в кровьяной плазме примерно 300 свиней. Образцы были взяты из крови опытных животных (свиней) кормленных фуражом различного состава; отчасти из крови, снятой перед убоем при обработке в скотобойне.

Наряду с содержанием токоферола было изучено и содержание витамина А и колестерина. (Для количественного определения всех трех компонентов применялся флуорометрический метод).

На основе результатов испытаний можно установить, что между свинями имеются значительные различия, прежде всего в отношении содержания токоферола в крови.

Доказанные, или возможные причины таких различий могут заключаться, главным образом, в составе кормов (содержание естественного и искусственного антиокислителей, удельный вес ненасыщенных жирных кислот, наличие продуктов автоокислительного преобразования жиров и т.д.).

Результаты предварительных опытов позволяют сделать вывод, что имеется взаимосвязь между содержанием токоферола кровяной плазмы и изменениями в жировых тканях (в продуктах, содержащих жировые ткани), происходящих "post mortem" или при хранении (обработке).

4.8

ANALYSIS OF SOME BIO-ACTIVE COMPONENTS OF PIG'S BLOOD

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Introduction

The biochemical state of the muscle and adipose tissues, the quality of the products prepared from them considerably depends on the physiological state of the animals to be processed in the slaughter house. The assumption that there are relationships between the concentration level of certain biologically active components of blood and the post mortem processes in muscle and adipose tissues is supported by several experimental data. Thus, an investigation of certain components of blood may furnish valuable information on changes to be expected in conjunction with quality, storage and processing. On the other hand, these investigations are suitable to follow the effect of feeding factors and promote thereby the development of an optimal feeding system.

The equilibrium system of redox processes is an important characteristic of the physiological state of the organism.

Though peroxides and free radicals are normal metabolites of the living organism, formed within the range of the functional biochemical system of the organism and indispensable for normal life function processes, they can start at the same time abnormal oxidation reactions and chain processes of peroxidation of the living cell components, too. Therefore, the presence of free radicals is a constant source of the hazard of autooxidation. The toxic and harmful effects of peroxidation processes on the organism have been studied by many authors. If the main substrates of the autooxidation are unsaturated lipids, components of the cell membrane, then one of the most important results of autooxidation is the lesion of these membranes, the changing of their structure and function.

Moreover, peroxides formed during the peroxidation of tissue lipids are toxic compounds, able to oxidize and denature many other important components of the cell.

In the living organism presumably a special system regulating free radical processes and a peroxidation-preventing mechanism are active. The living organism has at least two such mechanisms. The precondition of the first, non-fermentative mechanism is the presence of antioxidants and reductases in the tissues, which inhibits the development of peroxidation processes. In addition to the antioxidant-reductase system another, fermentative protecting system, preventing peroxidation processes, is present in the living tissues. This system includes those enzymes and enzyme systems, which inactivate free radicals and peroxides.

In the regulation of peroxidation processes, feeding factors play also an important role. Together with the nutrients a certain quantity of peroxide, mainly lipid peroxide, is introduced into the organism, the main sources of which are the fats of the nutrients, because these may be oxidized in a small measure during storage and processing. Diseases are described in the literature, developed e.g. in pigs, by the action of fodder containing a large quantity of oxidized fat.

Nutritive /feeding/ factors promoting peroxidation may be the following:

- antioxidant deficiency,
- peroxidation products in the nutrients,
- predominance of unsaturated lipids,
- excess of pro-oxidants,
- insufficient protein, etc.

It has been proved experimentally /1,2,3,4/ that tocopherols participate in the antioxidant system of the organism, controlling the intensity of the free radical processes under physiological conditions. DIPLOCK et al. /5/ showed that the biological role of vitamin E may be also the formation of complexes with the hydrocarbon chains of poly-unsaturated fatty acids in the lipoprotein membranes, and the protection from oxidation of selenide, attached to non-hem-iron contained in the proteins of catalytically active sulfur content of the mitochondria and the smooth endoplasmic reticulum.

For the following in vivo changes caused by inadequate feeding, a more detailed study than up to the present of the fine composition of blood transporting nutrients seems to be suitable, with particular view to the qualitative and quantitative elucidation of the vitamin composition of blood plasma.

The main objects of our work reported in this paper were the following:

In want of basic data, first of all the range of the tocopherol content of the blood plasma of pigs, consigned from different breeding farms for processing at the Slaughter-house of Budapest had to be established.
- In possession of the results of these introductory and essentially assessing investigations, two experimental series have been carried out. In one of these, the finer composition /total lipid, total cholesterol, tocopherol and vitamin A content/ of the blood plasma of pigs to be slaughtered, and fed on fish-meal of various qualities and quantities has been investigated. In the other series the tocopherol content of the adipose tissue of animals thus controlled has been studied at time of slaughter and after 6 weeks of cold storage, respectively. The feeding experiments have been carried out by Juhász, and coworkers in the Physiological Department of the Research Institute for Animal Husbandry Herczeghalom and the chemical investigations of the blood-plasma by us.

Materials and Methods

Total lipids were determined according to JACOBS et al. /6/, total cholesterol according to SOLOW and FREEMAN /7/, Tocopherols according to STÖRER /8/ and vitamin A according to THOMSON et al /9/ by fluorometry.

Results and discussion

As was to be expected, the tocopherol content of the blood plasma of individuals of herds /each 15 animals/ from different breeding farms varies considerably. The blood plasma tocopherol values of the animals of the herds, the mean values and standard deviation are shown in Fig. 1.

Before feeding, the composition of the fodder was naturally checked on its main characteristics, with special view to the tocopherol and the total fat contents. The tocopherol /fat ratio, which may give for the quality of the fodder a relationship easy to interpret, has also been calculated. The following table /Table 1/ summarizes these test data for both kinds of fodder, containing various percentages of fish meal of good and poor qua-

lity, respectively.

Special attention should be called to the tocopherol/fat ratio mentioned already, the good level of which in the lst feeding series meets world requirements - according to the literature - while it is decisively poor in the 2nd feeding series, particularly in the fodder containing 10 % of fish meal additive.

The practical importance of this tocopherol/fat ratio and its applicability in pig breeding becomes still more evident from respective data in Table 2, which clearly show that fish meal of good quality, particularly the 10 % addition, conserves the original tocopherol content of blood plasma, this is simply and well indicated by the tocopherol/fat ratio, mentioned already several times.

In the 2nd experimental series, the presence of fish meal of poor quality considerably reduced the original tocopherol content, particularly when 10 % of poor quality fish meal was added, which is reflected also by the tocopherol/fat ratio /Table 3/.

These rather complicated relationships can be clearly seen from Figs. 2-7.

Data presented for the two experimental series show that an increase of the oxidation products, e.g. peroxides, etc, of fodder components easily becoming rancid can be readily followed in the blood plasma composition of the animals, not only in the light of the tocopherol/fat ratio, but also by taking into consideration the tocopherol/cholesterol ratio. Though the change in vitamin A content of the blood plasma has also been determined, and a similar tendency could be established, the number of available data does not seem to be sufficient to draw final conclusions.
On the other hand, the change in tocopherol content of the plasma is manifested so definitely that attempts were made to follow possible changes in the tocopherol content of pig adipose tissues, caused by feeding. The following Table 4 and Fig. 8 support this assumption. When feeding fish meal of high quality, the tocopherol content of the adipose tissues of pigs diminishes considerably less, that is to say, the adipose tissues of pigs properly fed are of higher physiological value.

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table 1

Some characteristic data of fodders used in the 1st and 2 nd feeding series

Type of fodder	Row protein /%/	Row fat %/	Sat. ac.	Oleic ac.	Linolic ac.	Tocopherols /mg/100g/	Vitamin A /µg/100g/	Tocopherols / Fat ratio	Peroxide number	Acid number
			% in tot.fat.ac.							
1. Normal pig-fodder	17,9	3,22	13,39	26,89	59,58	1,50	250	0,46	2	16
2. +10% fish meal of good quality	17,5	4,10	16,11	29,17	54,13	3,80	1000	0,92	6	15
3. +5% fish meal of good quality	16,9	3,70	15,28	27,95	56,74	3,40	820	0,92	4	10
4. +2% fish meal of good quality	17,3	3,80	22,89	34,25	42,86	2,85	620	0,75	3	16
1. Normal pig-fodder	15,0	3,29	20,46	27,56	50,70	3,80	820	1,15	2	18
2. + 10% fish meal of poor quality	15,4	4,31	20,78	29,30	46,31	1,40	250	0,32	15	45
3. +5% fish meal of poor quality	14,8	3,96	18,11	31,85	49,95	2,00	420	0,50	12	34
4. +2% fish meal of poor quality	15,0	3,60	30,56	36,43	32,92	2,90	530	0,80	10	25

table 2

Blood-plasma composition in the 1st feeding series at start and end of the experiment

Group number and type of fodder used	Total lipid /%/		Cholesterol /mg/100 ml/		Tocopherols /mg/100 ml/		Vitamin-A /µg/100 ml/		Tocopherols / Fat ratio		Tocopherols / cholesterol ratio	
	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
1. Normal pig-fodder	496 ± 57	356 ± 35	114 ± 6	70 ± 6	0,160 ± 0,035	0,113 ± 0,035	769 ± 48	506 ± 48	0,32	0,31	1,40	1,59
2. +10 % fish meal of good quality	493 ± 81	401 ± 61	123 ± 21	87 ± 10	0,673 ± 0,038	0,576 ± 0,028	1134 ± 115	904 ± 68	1,36	1,43	5,44	6,56
3. +5% fish meal of good quality	374 ± 54	432 ± 62	93 ± 14	94 ± 12	0,480 ± 0,027	0,430 ± 0,032	1050 ± 101	756 ± 80	1,28	0,99	5,15	4,53
4. + 2% fish meal of good quality	350 ± 34	368 ± 55	86 ± 14	83 ± 27	0,380 ± 0,032	0,300 ± 0,025	971 ± 85	756 ± 92	1,08	0,81	4,38	3,59

The results are averages of 12-12 determinations. Every group consisted of four pigs.

table 3

Blood-plasma composition in the 2nd feeding series at start and end of the experiment

Group number and type of fodder used	Total lipid /%/		Cholesterol /mg/loo ml/		Tocopherols /mg/loo ml/		Vitamin-A //µg/loo ml/		Tocopherols / Fat ratio		Tocopherols / Cholesterol ratio	
	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
1. Normal pig-fodder	399 ±64	398 ±29	85 ±11	79 ±12	0,485 ±0,025	0,482 ±0,028	802 ±54	800 ±38	1,21	1,21	5,68	6,04
2. +10 % fish meal of poor quality	425 ±45	286 ±27	98 ±12	60 ±6	0,432 ±0,018	0,088 ±0,012	800 ±47	417 ±41	1,01	0,30	4,40	1,46
3. +5 % fish meal of poor quality	329 ±35	365 ±82	73 ±10	78 ±8	0,425 ±0,032	0,104 ±0,025	832 ±58	545 ±37	1,29	0,28	5,79	1,33
4. +2 % fish meal of poor quality	362 ±46	404 ±55	76 ±4	81 ±7	0,440 ±0,025	0,252 ±0,018	830 ±39	660 ±47	1,21	0,62	5,78	3,10

The results are averages of 12-12 determinations.Every group consisted of four pigs.

table 4

Variations in the tocopherol-contents of adipose tissues from the 1st and 2nd feeding series during sixty days storage

1st experiment				2nd experiment			
Group	Tocopherols /mg/100 g/		Decrease of tocopherols /%/	Group	Tocopherols /mg/100 g/		Decrease of tocopherols /%/
	at start	after 60 days			at start	after 60 days	
1.	0,70	0,51	27,5	1.	0,61	0,41	32,1
2.	2,48	1,48	40,3	2.	0,21	0,10	51,1
3.	1,72	0,92	46,6	3.	0,34	0,17	49,1
4.	1,25	0,70	44,1	4.	0,47	0,25	47,0

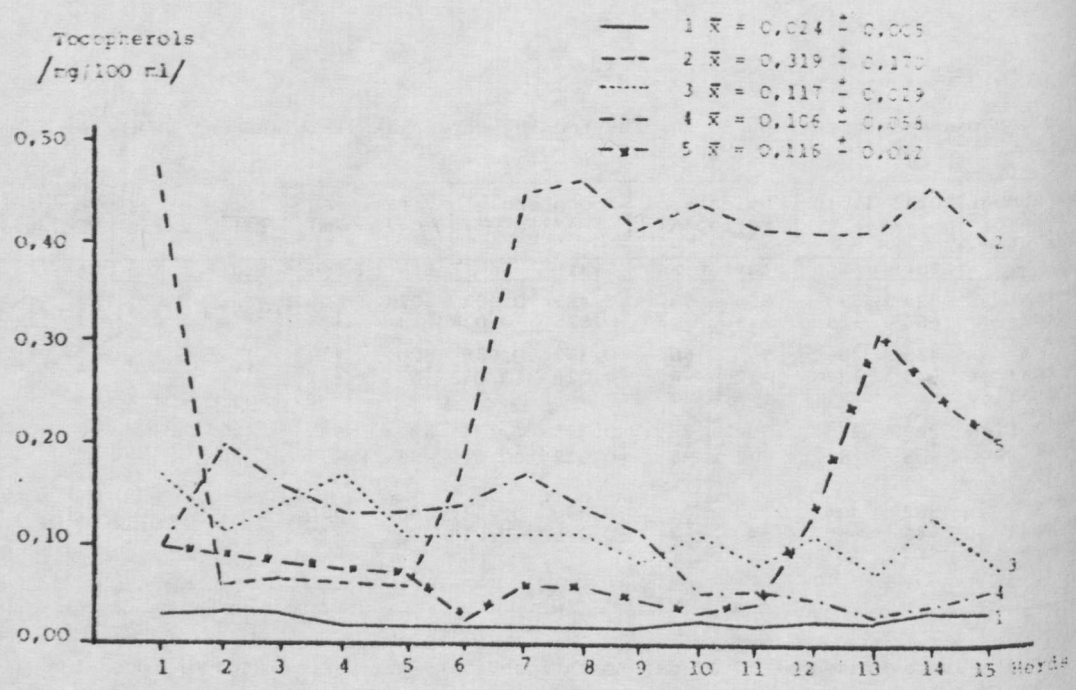

Fig. 1. Blood-plasma tocopherol values of the animals of the single herds

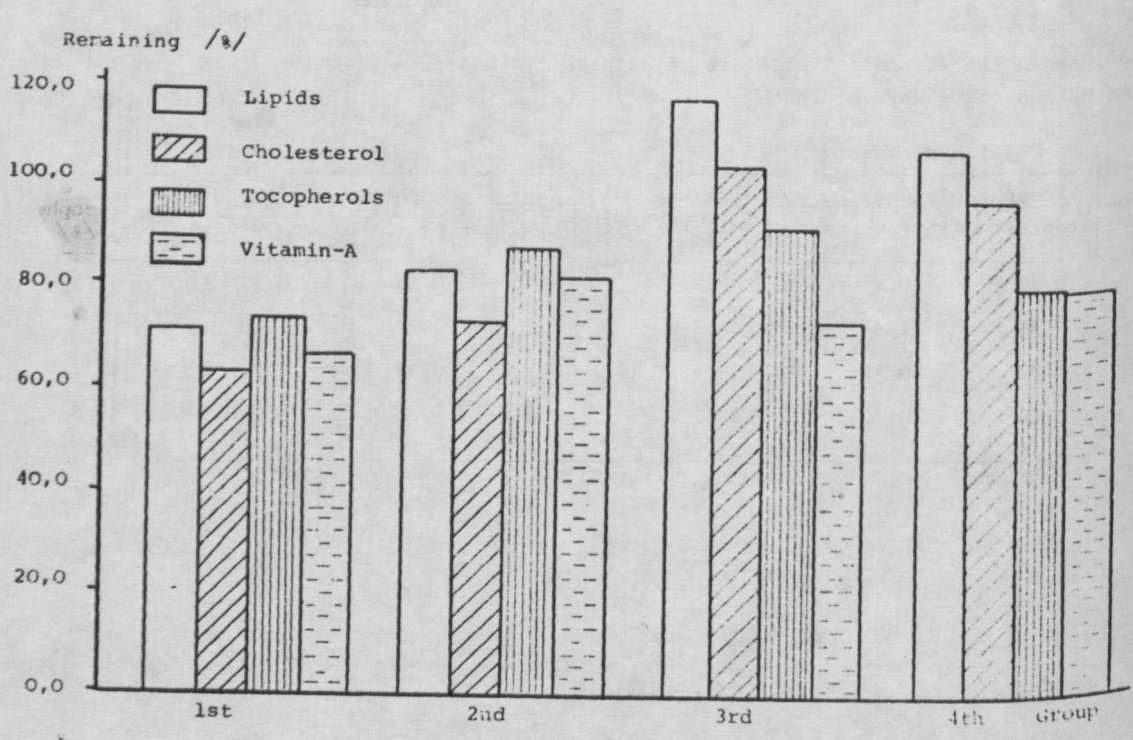

Fig.2. Total lipids - cholesterol - tocopherols and vitamin A - in the blood-plasma /1st series/.

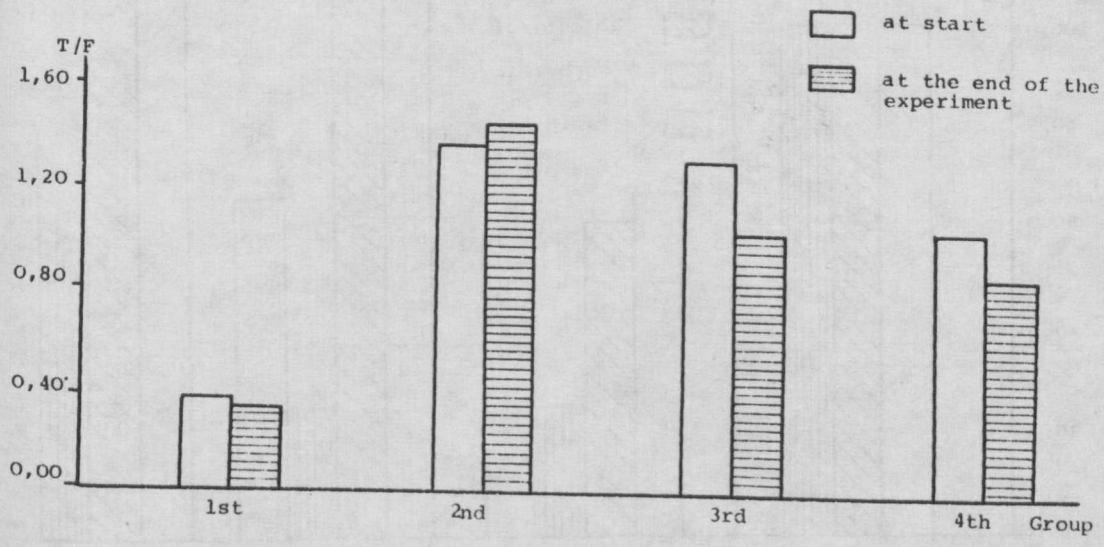

Fig.3. Tocopherols/Fat ratio in the blood-plasma /1st series/

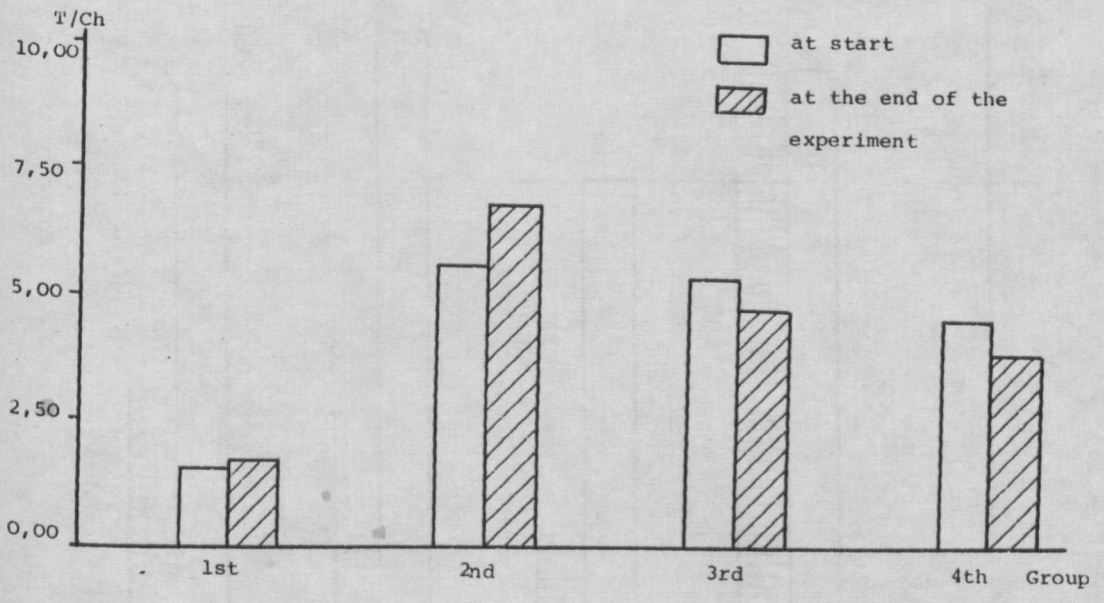

Fig.4. Tocopherol/Cholesterol ratio in the blood-plasma /1st series/

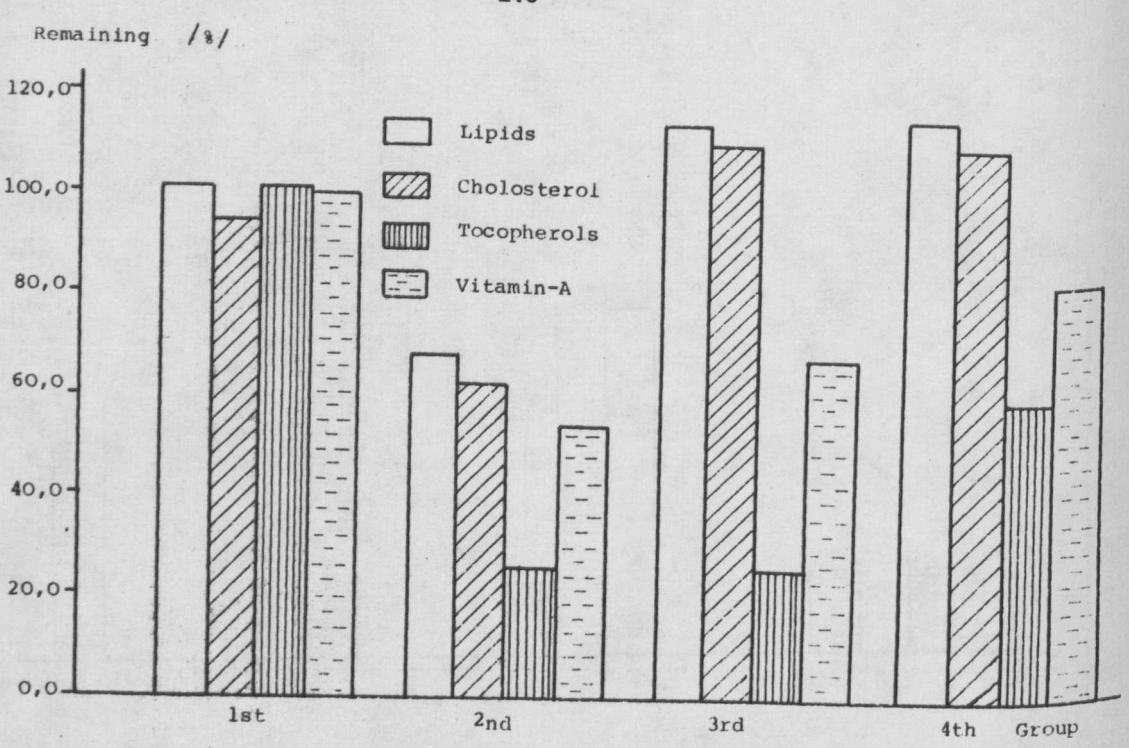

Fig.5. Total lipids-cholesterol-tocopherols and vitamin A in the blood-plasma /2nd series/

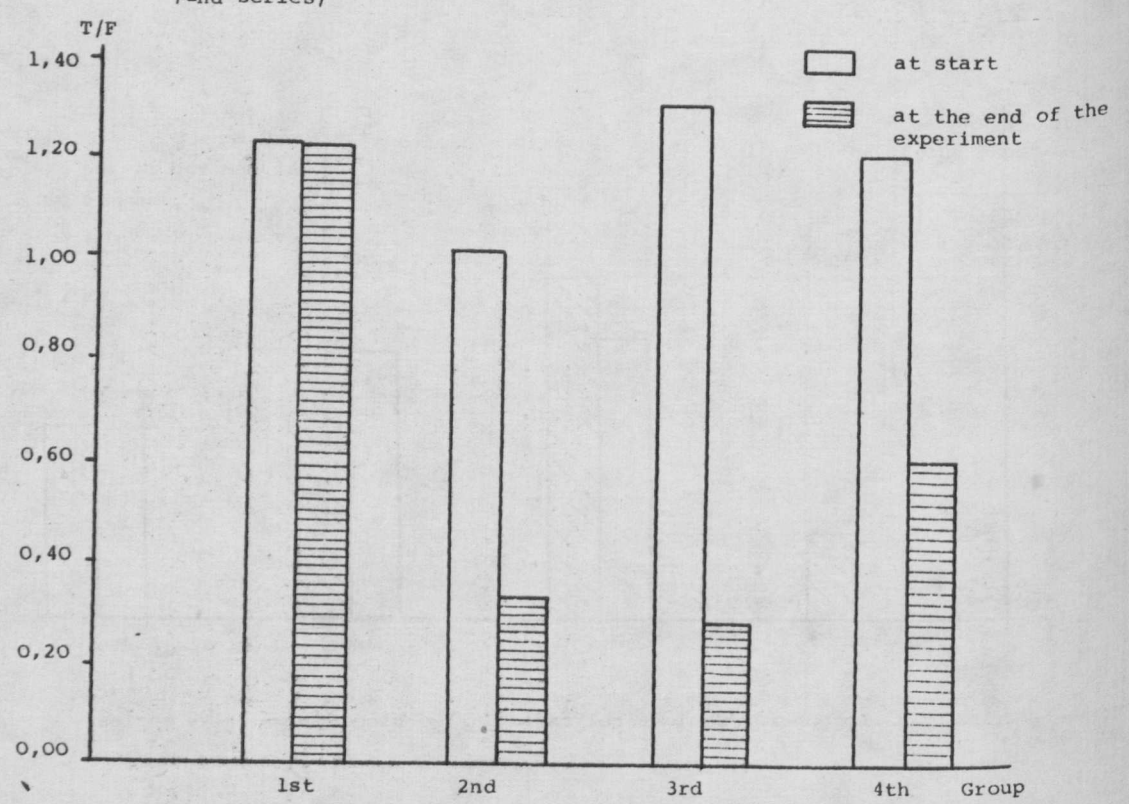

Fig.6. Tocopherols/Fat ratio in the blood-plasma /2nd series/

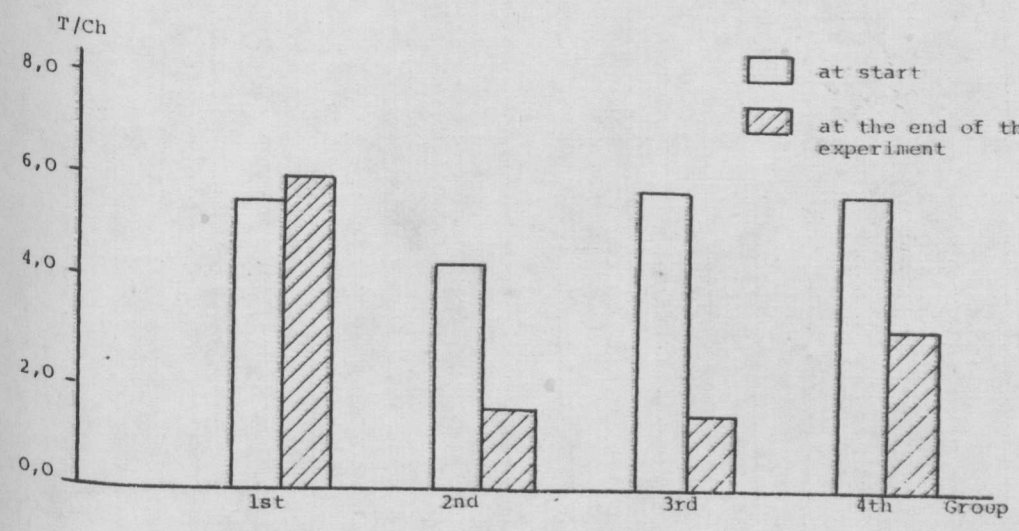

Fig.7. Tocopherols/Cholesterol ratio in the blood-plasma /2nd series/

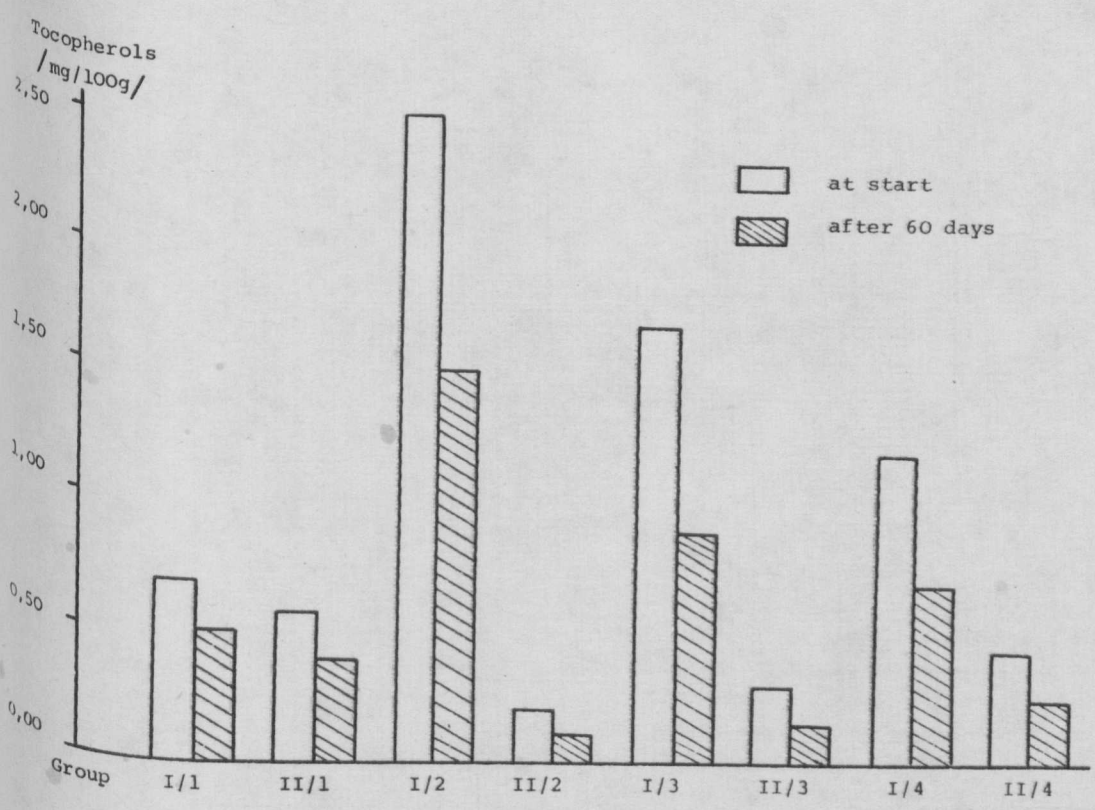

Fig.8. Variations in the tocopherol-contents of adipose tissues /1st and 2nd series/