DIGESTIBILITY AND NUTRITIVE VALUE OF ANIMAL FATS ON THE BASIS OF BIOLOGICAL STUDIES

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Beside of a meat, a fat tissue is the second basic raw-material obtained from the slaughter animals carcasses. The main part of the whole quantity are the swine and bovine fat tissues. The swine fat tissue is used almost in the whole in the processing of lard, sausages and canned products. On the contrary the bovine fat tissue is used only in the limited amount although its usability to some sausages and canned meat processing is not lower than this of swine fat. For example, the collagen - fat emulsions with the talk used for comminuted sausage processing are of higher value from the technological point of view, than these ones with the swine fat.

The data of digestibility and nutritive value of fats are of great importance for nutrition. The data may be useful in the working out the recipes of meat products. The nutritive value of the fat tissue depends mainly on their chemical composition which is very important from the digestibility point of view and physiological demands.

The way of preparation of the fat and its amount in diet has great influence on the degree of utilisation. It is known that higher degree of desintegration facilitates the digestion of fat however the intensive heating or hydrogenation has opposite influence.

The relative digestibility of fat can be described as a ratio of absorbed fat to the fat consumed with a diet.

$$\text{The relative digestibility} = \frac{\text{fat intake - fat in feces}}{\text{fat intake}}$$

By the estimation of the true digestibility the correction on the metabolic fat in feces of the animals on the non-fat diet is brought into.

The heated fat especially in the presence of oxygen, changes its chemical composition and biological properties (1,4,6,10), the partial polimerisation takes place, the iodic number decreases in this case and at the same time the digestibility of fat decreases. For example, the true digestibility of the fresh lard is about 95,7% and after frying, only 83%. There is found that the strong heating, especially manifold heating at the high degree of hydrogenation of the oil to the melting point of 51-59°C caused that the fat has toxic properties (3,8). It can be obvious especially at the high content of fat in the diet (about 73% of overall calories). The raw or rendered natural animal fat is harmless for healthy animals even when it is eaten in large amount.

The digestibility of different animal fat is aproximatelly the same, but there exists large difference in the rate of the absorption of particular kinds of fat, the poultry fat has the highest rate of absorption, then follows lamb fat, bovine fat, butter and lard (7). It is known that the digistibility of fat decreases paralelly with the increase of melting point. Ziombski (11) has shown in his experiments that the digestibility factor of the hydrogenated rape seed oil to the melting point of 38°C droped down from 93,7% to the 84,6%.

The value of digestibility factor for the talk is 94-95%, for the porcine lard - about 98%. The lower digestibility of natural fat with the high melting point can be the result of slower

digestion and absorption of fat from the digestion tract. The evaluation of nutritive value of the fat can be done only on a basis of long lasting experiments which allow to observe the differences in the development of animals and their physiological conditions. Many authors (3,4,5,6,8) investigated the influence of longer feeding with the diet containing some fat on the growth of animals, development of particular organs, the quantity of the fat in the tissue, the level of cholesterol in blood etc. The period of the experiment was usually between 6 and 18 weeks (2,4,5,8). In this paper the preliminary results of digestibility and nutritive value of bovine and porcine fats are presented. It is of great importance the estimation of biological properties of bovine fat because there exists common opinion that it has lower nutritive value.

Procedure and methods

The relative digestibility of the lard and talk and also bovine fat tissue was investigated. The fats were added to the diets in natural state and also as fat - water - protein emulsion. Emulsion consisted of fat (30%), water (67%), sodium caseinate (3%) and was prepared by homogenisator. The raw bovine fat tissue was added as:

a) Comminuted on the laboratory grinder
b) Comminuted as above and then amulsified using 3% of sodium casseinate as a emulsifing agent
c) Prepared as in b) using as a emulsifing agent 0,1% of lecithine.

The estimation of the fat digestibility was caried out using young rats, Wistar Strain (weight 50-60 g) and growing up rats (weight 250-280 g). Experimental groups of young rats had 4 animals and of grown up 10 animals. Every experimental groups was

treated as a whole. The cages were prepared in special case to the collection and separation of feces from remainders of the diets (Fig.1).

Before the experiment the animals were fed using standard diet with some carrot. During the experiment, the diet was given daily ad libitum. Three days of the preparatory period were followed by the main experimental period.

The basic content of the diet was following:

wheat starch	50%
sodium caseinate	15%
sucrose	15%
vitaminum mixture	5%
investigated fat	15%

To the each diet mineral salts mixture and vitamin B_{12}/20 kg of the diet (vitamin A+D_3 /3000 J.U./kg of the diet) was added.

The components of the diet were thoroughly mixed and supplemented by the water in such an amount, that its amount was about 30% in the ready-to-use diet.

The feces was gathered for 10 days of time between 3th and 13th day of experiment. The content of fat in feces was determined using Soxlet method.

The amount of consumed fat was calculated on the basis of the consumption level and the content of fat in the diets.

The results were expressed as relative digestibility.

Nutritive value of investigated fats was measured using method of growth on young rats (28 days old). Experimental groups of animals consisted of 8 or 10 individuals, with the equal number of males and females.

Composition of the diet was the same as in the experiments

of fat digestibility evaluation. The duration of the experiment was 6 weeks. The gains of the weight were controlled once a week, and expressed as a percentage increase gain related to the weight of the animals at the beginning of an experiment.

The fat content in rats carcasses was determined using Soxhlet method (the whole carcasses were used after the opening of body cavity and drying).

Results and discusion

The results of digestibility evaluation of investigated fats are given in a table 1.

Table 1

Age and sex of animals	Kind of fat in the diet	Way of preparation of fat	Fat intake g	Total of fat in feces	Relative digestibility
Young female	porcine fat	emulgated	54,9	1,09	98,0
young male	" "	"	46,7	1,56	99,7
grown up	" "	"	190,9	5,14	99,4
male " "	" "	non-emulg.	203,0	5,24	99,3
young male	rendered talk	" "	87,0	5,12	94,1
young female	" "	" "	78,1	4,65	94,0
grown up	raw talk	" "	98,8	5,61	94,3
male " "	" "	emulgated with addition of sodium casein.	92,8	3,66	96,1
" "	" "	emulgated with addition of lecithine	99,0	3,91	96,1
young male and female	porcine fat in the diet with the comminuted sousage	A	92,8	1,02	96,8
		B	29,4	0,93	96,8

The above presented results show that porcine fat digestibility is very high and emulsifing of this fat has no effect on its digestibility. However the non-emulsified talk is a bit lower (94% in comparison with 96% to emulsified talk).

Digestibility of the talk is lower 2-5% in comparison with that for the lard.

The lack of the emulsifing effect on the lard digestibility can by the result of the high dispersion of the lard in starch during the preparation of the diets. The microscopic picture of the diet shows that the diameter of the fat balls in the emulsion did not differ too much from those in the non-emulsified fat in the diet, what seems to confirm the above mentioned supposition.

There is no difference in the digestibility factor obtained on the mature and on the young animals and also on the group of male and female rats.

Independently of the investigations on the fats given directly to the diet, the digestibility of the fat in the comminuted sausage (frankfurter type) was also estimated. The sausage farce was added in a certain amount to the diet prepared for the investigation of protein biological value. The digestibility of the porcine fat in the sausage was about 2% lower than that of the lard. The fat to the sausage was added as a fat tissue and its dispersion in the diet was lower than that of the lard, what probably has the cause of obtained results.

The results of nutritive value evaluation are presented in the table 2.

Table 2

Sex	diet with the talk				diet with the lard			
	initial weight	terminal weight	gain weight %	Fat in carcass	initial weight	terminal weight	gain weight %	Fat in carcass
female	54	139	257	35,0	49	131	267	37,5
	55	154	280	35,2	49	129	263	36,5
	50	144	288	34,6	55	152	276	36,1
	66	153	232	34,8	49	134	273	34,3
	60	150	234	35,1				
average			259,6	34,9			270,3	36,1
male	65	200	307	31,9	56	138	246	31,9
	63	205	325	31,3	55	138	251	32,5
	57	177	310	32,1	51	140	274	32,8
	56	181	323	31,8	54	144	266	34,0
average			316,6	31,8			259,2	32,8
			283,7	33,3			264,6	34,4

The data show that the effect of both investigated kinds of fat (lard and talk) on the weight gain of the experimental animals is quite the same, it allows to state, that they have approximately the same nutritive value and similary physiological usefulness for growing animals.

There is no difference in the weight gain and the quantity of the fat in tissues in group of female animals kept on the diet with the talk and that with the lard. In the males higher weight gain and lower amount of fat in tissue is observed for the diet with talk, what indicates slight better nutritive properties of the talk. It can be underlined that during the experiment the in-

take of the diets with both fats was quite equal therefore this factor could not result the difference in the weight gain and the degree of tissue fatiness.

No differences in health condition of all groups of experimental animals during the experiment are observed. Also the section picture of inner organs shows no differences and no pathological changes.

The results show that the emusification of the fat has higher effect on the digestibility of talk than on the digestibility of porcine fat. The digestibility and nutritive value of both fats is very close. The data show that it would be desired to extend the utilisation of talk in food processing.

Conclusions

1. The digestibility of lard and talk and their effect on the growth of experimental rats are quite similar.
2. It is found that emulsification has only slight effect on the digestibility of fat in diet.
3. The age and the sex of animals show no significant influence on the results of digestibility estimation.

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