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INFLUENCE OF THE OXIDATION LEVEL OF FODDER FATS (OILS) ON THE QUALITY OF PRODUCED FOWLS' LIPIDS

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Abstract. Studies were conducted on the oxidation rate, the oxidation stability and vitamin E content in lipids from poultry feeds as well as in such, isolated from the muscle tissue and liver of poultry fed oxidised fats. A high oxidation rate was established in the feed lipids (peroxide number 19.5-88.2 meq/kg, acid number 24.5-98.2 mg KOH/kg, low oxidation stability and vitamin E content of 0.24 to 14.5 mg%). The liver lipids, isolated from poultry given daily 100 mg vitamin E, were free of peroxides only on the day of slaughter. With the time of storage, they increased both in the experimental and the control poultry. The daily per os giving of vitamins E and A in the form of Geritamin for 20 days before slaughter did not prevent the oxidation of lipids, i.e. vitamin A manifested a pro-oxidative effect on lipids, similar to that of carotenoids.

Keywords: fodder fats, oxidation, poultry, quality.

AIMS AND BACKGROUND

The tocopherols possess two major properties to catalyse the biochemical processes and to inhibit some oxidising processes *in vivo* and *in vitro*[1].

The lack or insufficient quantity of tocopherols in the different cells, tissues and organs of animals is a signal for beginning of undesired autoxidising processes. If these processes are not interrupted in time, pH is changed, the proteins metabolism is disturbed, some biologically active complexes are broken down and finally, non-reversible damages of the cell structures are established[2-5]. Peroxides, ketone, keto- and hydroxy acids and some other physiologically harmful metabolites are accumulated in the cells. They strongly decrease the biological sufficiency of the animal products[1,6,7].

During the last years, a special attention has been paid to the production of meat products stable to oxidation as well as increasing the lipid stability in the animal food products by adding of vitamin E or some other antioxidants. Increasing the concentration of vitamin E in the animal food leads to increase in the quantity of the vitamins in their tissues. Thus, the stability of those tissues against

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965

the lipid oxidation increases[8,9]. We did not find literature data for the connection between the extent of oxidation and lipids in fodder for fowls' cramming and the concentration of vitamin E in them, and their relation with the oxidised products within the meat, its stability and the time limit for storage, which has determined the focus of our research.

EXPERIMENTAL

We studied 55 numbers of fodder for poultry and components for their production. The lipids were extracted according to the method of Sokslet with pure from peroxides petroleum ether. After elimination of the solvent by vacuum evaporator, the fat was scavenged with an inert gas, and then stored in dark at -20°C, until concluding the research study.

The peroxide number (PN), the acid number (AN) and the iodine number (IN) were determined, according to the BSS 1552-86. The oxidising stability of extracted lipids was determined by Rancimat 679, firm Metrohm AG, Horisaw[10]. The method is conductometric determination of volatile products from the oxidation, which are collected into a container with deionized water.

The vitamin E content was determined by a liquid chromatography apparatus Merck-Hitachi, chemiluminescent detector F1050.

The impact of the oxidised fodder products on the quality of produced by fowls lipids was followed on 4 groups by 15 numbers of ducks in regime of forced crop, gizzard. The first group was left as a control. That group received food only according to the accepted technology. The fowls from the second group took by one tablet Geritamin (100 mg vitamin E and 30 000 UI vitamin A), every day during 20 days before butchering; from the third group – by 100 mg vitamin E and from the fourth group – Geritamin and 100 mg vitamin C.

Until the 6th hour of the butchering of the fowls, we took materials from muscles, fats from round the muscles and the liver. The lipid extraction from them was conducted by the method of Keits[11]. Their oxidising stability and the vitamin E content were determined by the methods described above for the fodder lipids.

RESULTS AND DISCUSSION

From Table 1 is seen that the lipids from the fodder mixtures for fowls and from the components for their production are with a high range of oxidation – from 23.56 to 74.86 meq O_2/kg. The high peroxide numbers correlate mostly with the high acid numbers – from 29.83 to 69.26 mg KOH/kg by norm of 7 mg KOH/kg.

966

Table 1. Results from the analysis of lipids, extracted from mixtures for fowls and from components for their production – peroxide, acid and iodine numbers, oxidising stability and vitamin E content

Kind of sample	Peroxide number (meq O_2/kg)	Acid number (mg KOH/kg)	Iodine number	Vitamin E content (mg %)	Induction period (h)
Soya bean groats	29.61	69.26	92.15	6.3	3.0
Sunflower groats	27.20	29.84	115.2	15.5	2.7
Carcass meal	74.86	48.53	46.24	11.5	3.0
Granulated fodder	23.56	56.48	113.66	68.2	3.0
Lard (control)					1.8

The iodine numbers, as a sign of non-saturation, are approximately the same, excluding the carcass meals, which suggests a close lipid-acid content. The vitamin E content is low in all kinds of fodder. It is usually around and above 50 mg% in fresh oils from plant origin like sunflower and soy a bean groats. The established higher percentage of vitamin E in the granulated fodder is due to the added vitamin premixes by the fodder preparation.

The results show also that because of the high initial range of oxidation, all extracted lipids have similar (close) induction periods of oxidation – 2.7-3 h. For the lard, used mostly as a control, this period is 1.8 h, correlated with about 3 months period of goodness.

The results of fowls' feeding with oxidised fodder and received in addition vitamin E, vitamin C and Geritamin are presented in Table 2. It is seen that the isolated lipids contain peroxides right at the day of butchering – 5.05 meq O_2/kg for the roundmuscular and 20.83 meq O_2/kg for the intramuscular fat. Only the liver lipids are free of peroxides at that day. The content of oxidised products in lipids of fowls, fed with Geritamin in addition is 8.8 meq O_2/kg for the roundmuscular fat and 11.2 meq O_2/kg for the intramuscular fat. The fowls received vitamin E and Geritamin with vitamin C at the day of butchering do not contain peroxides. They are not found in the liver lipids, as well. The effect of the vitamin addition was determined only in relation to the AN (acid number) at the first day after the butchering. The fridge storage of fats do not stop the oxidising processes in them as a result of which the AN continues to increase.

The α-tocopherol content in fowl lipids is insignificant – from 0 up to 0.83 mg%. It was the highest in lipids of fowls, received (obtained) in addition vitamin E only in intramuscular and liver fat – 17.85 and 7.36 mg%, respectively.

The obtained results show a that the fodder mixtures used in the poultry-breeding contain in their bigger part fats with a low content of vitamin E and a high initial range of oxidation and can be considered as a toxic right before to be used for food. The essential lipid acids, phospholipids, tocopherols, sterols, etc. affected by the oxidation decrease the food value not only of the fats, but also of

967

Table 2. Results from analysis of fowls' lipids (after everyday oral acceptance of vitamins E, A and C during 20 days period before their butcher)

	Sample	Peroxide number (meq O_2/kg)				Acid number (mg KOH/kg)				Vitamin E content on the day of butcher (mg%)
		1st day	30th day	60th day	90th day	1st day	30th day	60th day	90th day	
Roundmuscular	C	5.05	33.71	35.10	41.36	6.32	6.80	7.15	8.30	0.00
fat	3	0.00	7.70	27.70	30.60	0.90	1.22	7.24	9.18	0.74
	2	8.80	24.70	40.10	65.30	0.30	1.40	8.34	9.60	0.13
	4	0.00	21.10	49.80	63.10	0.90	1.36	8.00	14.30	0.51
Intramuscular	C	20.83	24.35	26.04	27.00	28.00	31.05	31.00	32.00	0.83
fat	3	0.00	28.30	33.00	34.50	5.20	10.28	14.30	19.40	17.85
	2	11.20	23.80	26.50	35.30	4.30	8.92	12.26	17.90	6.50
	4	0.20	31.30	37.30	42.20	4.50	10.72	11.72	19.40	5.76
Fat from liver	C	0.00	0.00	0.00	0.00	10.30	11.00	12.00	13.00	0.17
	3	0.00	0.00	2.10	2.30	2.40	7.66	9.25	9.80	7.36
	2	0.00	1.60	1.80	2.80	2.20	8.40	18.90	19.60	4.15
	4	0.00	0.40	0.50	2.30	2.10	8.00	13.00	14.36	3.16

C – control; 2 – received vitamin E; 3 – received Geritamin; 4 – received Geritamin and vitamin C.

the fodder as a whole. They are also very harmful for the animal organism[4]. The high content of poly-nonsaturated butyric acids supposes a high rate for the reactions with atmospheric oxygen[5]. From the other side, the low tocopherol content is not able to stop the on-going process of autoxidation as a result of which the oxidation stability of the lipids is with a short induction period and a short period of storage, even when natural and artificial antioxidants are used. Thus, the used combinations of vitamins A, E, and C do not lead to sufficient accumulation of vitamin E in the physical fats (lipids) of the fowls, to delay of the oxidising processes, and to prolongation of their storage term.

The synergism in regard to the action of vitamins A, E, and C is known. The addition of vitamin C improves the assimilation of vitamins A and E, and decreases the animal needs of these vitamins in their ration. In order to receive an optimum biological effect and unidirectional action, it is necessary 1 kg of fodder to contain 10 000 UI of vitamin A and 20-30 mg of vitamin E. If the quantity of vitamin A increases, and the vitamin E content decreases the result is an antagonism and negative biological effect[3].

Nevertheless, the effect of Geritamin in our case remained the lowest in regard to the accumulation of vitamin E in the lipids (from 0.13 to 6.5 mg%), and from there to the range of oxidation of fowls' lipids, by which PN and AN right at the day of butchering were with high values – 8.8-11.2 meq O_2/kg and 0.3-4.3 KOH/mg, respectively. We assume, that in this case, vitamin A has shown some prooxidising action. In some particular cases, the complex containing vitamins A and E practically does not show any positive effect. Because of that, Orvidas and Rutkauskas[12] recommend the individual acceptance of vitamin A, when much better effect is received than by the combined acceptance of both vitamins.

In spite of the strong antioxidising action of vitamin C and vitamins A and E, we did not receive the desired positive effect during the storage of fats. We consider that vitamin C serves as an inhibiting factor in relation to the prooxidising action of vitamin A, because of which its antioxidising effect remains unrealised.

CONCLUSIONS

Lipids isolated from fodder and fodder components for fowls are with a high range of oxidation and a low content of vitamin E. Giving vitamin E (per os) in dose 100 mg daily for fowl, 20 days before the butchering, do not result to apparent accumulation of the vitamin in the body fats (barely 0.74-17.8 mg%) as well as to inhibition of the oxidising processes in them. The high concentration of peroxides in the fodder inactivates the antioxidising action of α-tocopherol in the process of their accelerated oxidation. Even the combination of vitamins A (10 000 UI), E (70 and 100 mg), and C (100 mg) are not able to get this process under control.

969

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970