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EFFECT OF INCREASED LEVELS OF VITAMIN A IN FEED ON QUANTITY AND QUALITY OF ABDOMINAL FAT IN CHICKENS UNDERGOING FATTENING PROCESS

UČINAK POVEĆANIH KOLIČINA VITAMINA A U HRANI NA KOLIČINU I KAKVOĆU TRBUŠNE MASTI PILIĆA U TOVU

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SUMMARY

The research involved a total of 280 fattening chickens (Hybro) divided between two identical experiments (4 groups of 40, and 4 groups of 30 chickens), with the aim of investigating reproducibility of data. During the 42-day course of fattening the effect that increased levels of vitamin A in chicken feed had on the quantity and quality of abdominal fat was researched. Control groups of chickens were fed on commercial starter and finisher rations containing the standard level of vitamin A (12.500 and 10.000 i.u.). The three experimental groups of chickens were fed on starter and finisher rations containing the same nutritional values but with an increased level of vitamin A (25.000, 37.500, 50.000 i.u. in starter rations and 20.000, 30.000 and 40.000 i.u. in finisher rations). Measuring of abdominal fat in chickens conducted at the end of both experiments showed that increased levels of vitamin A in feed resulted in no significant increase ($P<0.05$) of fat share in overall body mass when compared with the control group of chickens. Results of quality control of abdominal fat (peroxide number and degree of acidity) also showed no significant difference ($P<0.05$) between control and test groups of chickens.

Key words: feed, fattening, vitamin A, and abdominal fat, chicken

INTRODUCTION

Numerous research projects into the effects that vitamin A contained in feed has on poultry production results and state of health produced data on the minimum and optimum requirements of vitamin A in feed (Adams and Bauernfeind, 1963; Findrik et al., 1964; Scott et al., 1982; Anonymous, 1977; Kalivoda, 1986; Siegman, 1983; Degussa, 1987; Mcdonald et al., 1988; Šerman, 1989; Šerman and Findrik, 1989; Cook, 1991; Mazija et al., 1992).

When adding vitamins to feed mixtures, including vitamin A, the livestock feed industry adheres as a rule to generally known and accepted scientifically based standards. However, these standards are applied too routinely, with no attention being paid to the fact that many known and unknown factors (genetic and paragenetic) alter the requirements,

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which means that accepted dosages are unsatisfactory in all cases. The effect of vitamins is also influenced by composition of the feed itself. For example, energy-rich feed demands a greater quantity of vitamins than feed of lower energy value. A surplus of proteins in feed increases the need for vitamin A, while the presence of nitrite, sulphite, antibiotics, anticoccidials or chemotherapeutics increases the need for all vitamins in poultry.

Results of the research carried out on fattened chickens (Šerman and Mazija, 1985; Šerman et al., 1992; Mas, 1996) showed that of all the tested levels of vitamin A in feed (2.500 to 20.000 i.u. of vitamin A/kg of feed) the most favourable effect on body mass growth and value of the HI titre was achieved through the addition of 20.000 i.u. of vitamin A. VAHL and van CLOOSTER (1987) state that increased levels of vitamin A in chicken feed (63 mg of retinol equivalent per kg of feed mixture for broilers) reduce digestibility of fats and level of utilisation of metabolic energy, which leads to stunted growth. Sufficiency of vitamin A in feed (330 mg/kg) increases the quantity of zinc in plasma and liver of chickens (Sklan et al., 1987). Tang et al. (1985) stated that A hypervitaminosis in chickens is clinically manifested by staggering, lack of appetite, stunted growth, conjunctivitis, diarrhoea and irregularities in skeletal development.

Since the data related to the effect which increased levels of vitamin A in feed have on health and production results of fattened chickens are extremely wide ranging, the aim of this particular research was to establish the effect of increased levels of vitamin A in feed on health of chickens and production results (body mass, accumulation and quality of body fat) achieved during a 42-day fattening course.

MATERIALS AND METHODS

The research involved 280 fattening chickens and comprised two experiments. The first experiment involved 160 chickens divided into four groups - one control and three experimental groups. Each group comprised 40 animals. The second experiment covered 120 chickens, also divided into four groups, but of 30 animals each, with one control group and three experimental groups. The fattening process in each experiment lasted 42 days. Chickens were placed in fattening cages and received feed and water *ad libitum*.

Ambient temperature, lighting, humidity and air circulation were all maintained within technological standards. On day 14 chickens were vaccinated with Newcastle disease La Sota vaccine (oculonasally). Health checks were conducted on a daily basis. Every expired chicken was dissected and cause of death was established.

In both experiments, body mass and feed consumption were controlled on a weekly basis. Up until day 21 animals were fed fattening starter rations for chickens (21% crude protein). From day 21 until the end of the 42-day fattening period chickens were fed a fattening mixture of finisher rations (18% crude protein). The nutritional value of both starter and finisher rations met the requirements of chickens undergoing the fattening process. Both mixtures were commercially produced. The difference between control and test groups was in levels of vitamin A.

Control groups in both experiments received 12.500 i.u. of vitamin A per kg of starter rations and 10.000 i.u. of vitamin A/kg of finisher rations. Experimental groups were given differing levels of vitamin A in starter and finisher mixture rations (table 1).

Table 1. Levels of vitamin A in feed mixtures

	Vitamin A/kg - starter rations	Vitamin A/kg of finisher rations
E1	25.000 i.u.	20.000 i.u.
E2	37.500 i.u.	30.000 i.u.
E3	50.000 i.u.	40.000 i.u.

At the end of the 42-day fattening period the quantity and quality of abdominal fat were analysed. Within the first experiment 15 animals in each group were sacrificed; within the second experiment 10 animals were sacrificed. The quantity and body mass of slaughtered chickens were established in

both experiments, as was the peroxide number of abdominal fat as an indicator of hydrolytic breakdown of fat. The first stage involved cold extraction of crude fat by means of chloroform. The acidity level was then determined using neutralising alcohol, and the peroxide number in accordance with the Wheeler method (Swern, 1972). All obtained results were statistically processed and subjected to T and F Test (Student and Fisher distribution).

RESULTS AND DISCUSSION

On the basis of the performed analysis it was established that the nutritional value satisfied the needs of chickens undergoing fattening process (Tables 1 and 2). Premixes for starter and finisher mixture rations in both experiments contained all necessary microelements, vitamins and other additives, with the exception of vitamin A.

Table 1. Nutritional value of chicken starter ration

Chemical composition	C	E-1	E-2	E-3
Crude protein g/kg	221.3	225.3	224.8	221.5
Crude fats g/kg	33.0	32.8	34.7	36.5
Crude fibre %	35.2	3,57	3,20	3,07
Ash %	60.1	5,49	5,50	5,46
Ca %	1,13	1,15	1,12	1,11
P %	0,54	0,48	0,49	0,46
Na %	0,20	0,20	0,20	0,20
Methionine %	0,45	0,47	0,48	0,45
Lysine %	1,15	1,11	1,14	1,13
MJ ME/kg **	12.481	12.662	12.566	12.537
KJ ME: 1% protein*	564:1	562:1	559:1	566:1
Vitamin A i.u.	12.500	25.000	37.500	50.000
Vitamin E i.u.	30	30	30	30

** Metabolic energy expressed in kJ per kg of mixture

* Quantity of metabolic energy per 1% of protein

Table 2. Nutritional value of chicken finisher ration

Chemical composition	C	E-1	E-2	E-3
Crude protein g/kg	184.2	181.7	182.5	180.7
Crude fats g/kg	40.2	34.5	32.2	40.6
Crude fibre %	3.75	3.19	3.19	3.57
Ash %	6.04	6.24	5.96	6.08
Ca %	1.16	1.15	1.10	1.15
P %	0.55	0.51	0.55	0.54
Na %	0.20	0.20	0.20	0.20
Methionine %	0.37	0.35	0.38	0.40
Lysine %	0.91	0.90	0.94	0.92
MJ ME/kg **	12.175	12.046	12.118	12.016
KJ ME: 1% protein *	661:1	663:1	664:1	665:1
Vitamin A i.u.	10.000	20.000	30.000	40.000
Vitamin E i.u.	25	25	25	25

** Metabolic energy expressed in kJ per kg of mixture

* Quantity of metabolic energy per 1% of protein

Analysis of mass involving 15 chickens in each group in Experiment 1, and 10 chickens in each group in Experiment 2, determined average body mass. In the first experiment the control group had an average body mass of 1663.20 g, the first test group (hereinafter 1E-1) 1558.13 g, the second experimental group (hereinafter 1E-2) 1663.00 g, and the third experimental group (hereinafter 1E-3) 1590.40 g. Comparison of the above results shows no significant differences in the body mass of control and test groups (Table 3). Average body mass in the control group of Experiment 2 was 1714.70 g, in the first experimental group (hereinafter 2E-1) 1675.20 g, in the second test group (hereinafter 2E-2) 1697.50 g, and in the third experimental group (hereinafter 2E-3) 1792.40 g. Comparison of results obtained again shows no significant difference between the body mass of control group and experimental groups (Table 4).

Average mass of abdominal fat in the control group of Experiment 1 (hereinafter 1C) was 27.24 g, while the experimental groups produced the following results: 1E-1 = 27.19 g, 1E-2 = 28.47 g, and 1E-3 = 26.25 g (Table 3). Average abdominal fat mass values in Experiment 2 were as follows: 2C = 24.66 g, 2E-1 = 25.49 g, 2E-2 = 24.62 g, and 2E-3 = 26.34 g (Table 4). Statistical processing of values of abdominal fat mass in both experiments yielded no significant difference between control and test groups.

As an indicator of oxidative breakdown of fat, the peroxide number provides no precise information with regard to the quantity of oxidising fat. Being unstable compounds, peroxides break down rapidly. Whereas a higher peroxide number is a positive indication of a more rapid oxidative breakdown, a lower peroxide number cannot be taken as a safe indicator that no breakdown has occurred. The average peroxide number in Experiment 1 was: 1K = 27.35, 1E-1 = 39.37, 1E-2 = 25.23, and 1E-3 = 36.08 (Table 3). In Experiment 2 the average peroxide number per groups was: 2K = 30.45, 2E-1 = 40.68, 2E-2 = 26.88, and 2E-3 = 48.27 (Table 4). Statistical processing of the above data once again produced no significant differences.

Table 3. Average body mass, abdominal fat, peroxides number and degree of acidity in control(C) and experimental (E) groups of chicks (the first experiment)

Group	N	Body mass (g)	Abdominal fat (g)	Peroxides number	Degree of acidity
1C	15	1663,20	27,24	27,35	1,38
1E-1	15	1558,13	27,19	39,37	1,57
1E-2	15	1663,00	28,47	25,23	1,88
1E-3	15	1590,40	26,25	36,08	1,61

N = number of chicks

Table 4. Average body mass, abdominal fat, peroxides number and degree of acidity in control(C) and experimental (E) groups of chicks (the second experiment)

Group	N	Body mass (g)	Abdominal fat (g)	Peroxides number	Degree of acidity
2C	10	1714,70	24,66	30,45	1,36
2E-1	10	1675,20	25,49	40,68	1,82
2E-2	10	1697,50	24,62	26,88	1,86
2E-3	10	1792,40	26,34	48,27	1,91

N = number of chicks

Contrary to the peroxide number, the degree of acidity does point to hydrolytic breakdown of fat and provides information on the quantity of free fatty acids (KARLSON, 1988), which is why these results are added to the hydrolytic breakdown of fat. In Experiment 1 the average acidity level was: 1K = 1.38, 1E-1 = 1.57, 1E-2 = 1.88, and 1E-3 = 1.61 (Table 3). Values in Experiment 2 were: 1K = 1.36, 2E-1 = 1.82, 2E-2 = 1.86, and 2E3 = 1.91 (Table 4). Statistical processing of data once again failed to establish significant differences.

Health condition monitoring and dissection of all perished chickens failed to establish any disease that would indicate problems related to vitamin supply. All deaths occurring in both experiments were linked to the consequences of stunted growth, or as a result of manipulation of animals (weighing, extraction of blood samples).

CONCLUSION

Bearing in mind the experiments conducted, as well as the results obtained from both experiments, the following conclusion may be made: increased level of vitamin A administered in starter ration (25.000, 37.500 and 50.000 i.u./kg of feed), and in the finisher ration (20.000, 30.000 and 40.000 i.u./kg of feed) during the course of the 42-day fattening period bore no significant influence on either the quantity or quality of abdominal fat.

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SAŽETAK

Istraživanje je provedeno na ukupno 280 pilića tovnih hibrida (Hybro) u dva istovjetna pokusa (4 skupine po 40, 4 skupine po 30 pilića) sa svrhom da se odredi reproducibilnost podataka. Tijekom 42 dana tova istražen je učinak povećanih količina vitamina A u hrani na količinu i kakvoću trbušne masti. Kontrolne skupine pilića hranjene su komercijalnim starterom i finišerom koji je sadržavao standardnu količinu vitamina A (12.500 i 10.000 IU). Tri pokusne skupine pilića hranjene su starterom i finišerom iste hranidbene vrijednosti ali uz povećanu količinu vitamina A (25.000, 37.500, 50.000 IU u starteru i 20.000, 30.000 i 40.000 IU u finišeru). Mjerenje trbušne masti pilića na kraju oba pokusa pokazalo je da povećane količine vitamina A u hrani značajno ne povećavaju (P<0,05) udio masti u ukupnoj tjelesnoj masi, uspoređeno s kontrolnom skupinom pilića. Rezultati određivanja kakvoće trbušne masti (peroksidni broj i stupanj kiselosti) također nisu ukazali na značajnost razlika (P<0,05) između kontrolnih i pokusnih skupina pilića.

Ključne riječi: hranidba, tov, vitamin A, trbušna mast, pilići