

OPTIMIZATION IN FEEDING OF BROWN HARE (*LEPUS EUROPAEUS*) KEPT ON FARM

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ABSTRACT

Pelleted feed mixture for brown hare has not been produced commercially in Slovakia, and feed mixtures for rabbits are used. Therefore, the aim of our research was to test and propose new pelleted feed mixture in order to meet required reproduction parameters, to increase muscle mass gains and to improve health in breeding brown hare ensuring higher potential of survival rate after releasing. The possibility to use secondary raw material from food industry to prepare the mixture was tested. Two formulations of pelleted feed mixtures were composed. Hot-air dried proteinous feedstuffs, wheat bran, oat, malt sprouts, secondary raw material after oat flake production, sunflower, sunflower oil meal, beet molasses as a binding material, supplement of vitamins and mineral elements were used. Commercially produced pelleted feed mixture for rabbits was used as a control. In the test of feed mixture with secondary raw material after oat flake production (FM I) during the period of intensive reproduction the number of young per one female was higher in the experimental group (3.25) compared to the control one (C 3.00), however, the results were not statistically significant. Average weight of young in a litter at similar age varied considerably and depended mainly on the number of individuals in the litter. Weight gains varied considerably within the period before weaning. Rate of gains was almost identical after weaning. Differences in average daily relative gains were not statistically significant.

Key words: brown hare; reproduction; weight; feed mixtures; nutrients; mineral elements; amino acids

INTRODUCTION

The possibilities to use secondary raw material from food industry as components to prepare the feed mixture were tested.

Hell and Slamečka (1999) reported that the feed mixture must contain balanced content of proteins and energy components, fibre, mineral elements and vitamins. They recommended complete feed mixture for rabbits kept in cages (BZ – Z). The authors recommended daily feed ration of 120 – 150 g. Fanta et al. (1984) and Kučera (1989) fed hares experimentally with the pelleted feed mixtures for rabbits MOK, KO – 16, KRL (VELAZ, Prague, Czech Republic). The hares well tolerated these feed mixtures.

The feed mixture for hares artificially fills their digestive tract, only then metabolic processes can be

completely engaged. Slamečka and Šebová (1991), Hell and Slamečka (1999) and Slamečka et al. (2001) reported average number of young - 2.3 in a litter, F.L.E.L. (1985) - from 2.2 to 2.5 young and Petersen (1990) - 2.5 young. Hell et al. (2006) mentioned that at average fertile female brings litters 3- 4 times a year and average number of young in a litter is 2.2-2.6 individuals. One female brings 8-10 young a year. Litter size varies during the year. Semizorová and Švarc (1987) reported that a female could have up to 5 litters a year considering the length of pregnancy 42 – 43 days. Mortality of leverets varies from 18 to 32 % (Slamečka et al., 1997).

The objective of this work was to monitor how the feeding of brown hares with the new proposed pelleted feed mixtures translates influences their reproductive parameters and weight of young on the local farm (APRC Nitra).

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MATERIAL AND METHODS

Hot-air dried protein-rich feedstuffs, wheat bran, oat, malt sprouts, secondary feed material after oat flake production, sunflower seeds, sunflower oil meal, beet molasses, supplement of vitamins and mineral elements and binding material were used. Experimental pelleted feed mixtures were produced on a small-scale pelleting line. The diameter of pellets was 3.4 mm; length - 15 mm. The control group was fed with commercially produced feed mixture for rabbits (VKZ Anprokrmí Ltd., Bučany). Composition and nutritional value of feed mixtures are presented in tables 4 – 6. Animals selected for the experiment were clinically healthy, housed in wooden cages with slatted floor, with run and asylum area. The cages were placed in an enclosed exterior. The animals had access to water in drinking bowls and were fed *ad libitum* once a day, with the exception of animals in feeding experiments. The pelleted feed mixtures (FM I) for brown hare, in the period of intensive reproduction (from 26th April to 24th June) were tested. Four pairs of parents were in the experimental group (FM I) and three pairs of parents were in the control group (C). The data of reproduction in one litter during the experimental period from 11th June to 4th August, which is the period during which the experimental feed could influence the reproduction, were recorded. The number of litters and number of young born in one litter were evaluated. Reproduction parameters during the whole calendar year (not only during the mentioned period) were observed.

Four females bearing approximately at the same time were selected to test the effect of different feed compositions. The experimental feed mixture (FM I) was fed to two pairs and control feed mixture (C) to two pairs. The young were weighed on days 14, 21 and 28 after the birth. During this period, the young consumed milk and pelleted mixtures, were also gradually included. Earlier weighing, immediately after the birth, was not necessary for the purpose of this experiment. On day 28 the young were weaned into a separate area and they received only pelleted feed mixtures. After weaning at the age of 35, 42 and 49 days animals were weighed. Also the relative daily gain in % (out of initial weight, which was measured on day 14 of age) was calculated. Content of nutrients in feed mixtures was determined according to the Decree of the Ministry of Agriculture of Slovakia on 7th October 1997 No. 1497/1-4/1997-100 on official sampling for laboratory tests and evaluation of feeds. The results were tested using MS Excel and SAS software; and the significance of differences in the given parameters was analyzed by a Bonferroni's test.

RESULTS

Table 1 lists the reproduction parameters of brown

hare fed with pelleted feed mixture with a secondary raw material after oat flake production (FM I) and control mixture; their formulation (in %) and content of nutrients (in g.kg⁻¹) are in tables 4, 5; contents of amino acids in feed mixtures for rabbits are listed in table 6.

Table 1: Evaluation of brown hare reproduction after feeding pelleted feed mixture with 10 % proportion of feed residua after oat flake production (FM I)

| Parental pair | Experimental group (FM I) | Control group (C) |
|-------------------------------|------------------------------|------------------------------|
| | n = 4 | n = 3 |
| | number of young per 1 litter | number of young per 1 litter |
| experimental period | | |
| x | 3.25 | 3.00 |
| s | 1.71 | 1.00 |
| s _x | 0.85 | 0.57 |
| V % | 52.54 | 33.33 |
| out of experimental period | | |
| x | 2.81 | 3.19 |
| s | 0.55 | 1.32 |
| s _x | 0.28 | 0.76 |
| V % | 19.71 | 41.24 |
| totally for the calendar year | | |
| x | 2.02 | 1.66 |
| s | 1.14 | 0.79 |
| s _x | 0.57 | 0.46 |
| V % | 56.59 | 47.71 |

Number of young in the experimental group (FM I) was 3.25 individuals per one female (one litter) and 3.00 individuals in control group (C). Reproduction of parental pairs out of the feeding period with experimental feed mixture was 2.81 young (FM I) and 3.19 young in control group (C); during the whole calendar year the number of young was 2.02 or 1.66, respectively. This study documents that the utilization of secondary raw material after oat flake production did not influence negatively the reproduction of brown hare.

Subsequently, two pairs of parents from each group were selected (FM I and C), which had the first litter approximately at the same time of the studied period. The young during the period of intensive growth were weighed to detect their live weight. The obtained results are shown in tables 2 and 3.

Average weight of young varied considerably at the same age, and with the exception of weight at the age of 21 days the obtained results were statistically significant ($P < 0.05$). Weight of young depended mainly on the number of individuals in litter and, therefore, calculation of relative gain had higher evidencing capacity.

Table 2: Observation of live weight in the period of intensive growth in brown hare after feeding pelleted feed mixture with 10 % proportion of feed residua after oat flake production (FM I)

| Parameter | 14. | 21. | 28. | 35. | 42. | 49 |
|---|-------|-------|-------|--------|--------|--------|
| Experimental group (FM I) age in days (n = 7) | | | | | | |
| x | 457 * | 701 | 957 * | 1179 * | 1386 * | 1550 * |
| s | 25 | 77 | 25 | 20 | 2 | 31 |
| s _x | 9 | 29 | 9 | 8 | 1 | 12 |
| V % | 5.36 | 11.03 | 2.56 | 1.70 | 0.16 | 2.01 |
| Control group (C) age in days (n = 6) | | | | | | |
| x | 492 | 633 | 925 | 1142 | 1310 | 1510 |
| s | 26 | 32 | 19 | 19 | 21 | 18 |
| s _x | 11 | 13 | 8 | 8 | 9 | 8 |
| V % | 5.25 | 5.10 | 2.09 | 1.66 | 1.62 | 1.17 |

*P ≤ 0,05

Table 3: Observation of relative weight gains in young brown hares (%)

| Age (days) | Experimental group (FM I) | | Control group (C) | |
|------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| | 1 st litter (n = 3) | 2 nd litter (n = 4) | 1 st litter (n = 4) | 2 nd litter (n = 2) |
| 14 | - | - | - | - |
| 21 | 23.2 | 20.9 | 18.4 | 18.4 |
| 28 | 17.9 | 21.0 | 21.3 | 20.1 |
| 35 | 17.4 | 17.7 | 17.9 | 17.2 |
| 42 | 16.5 | 17.1 | 16.4 | 16.4 |
| 49 | 15.7 | 16.2 | 16.5 | 16.5 |

From these numbers (Table 3) it follows that quite high variability in weight development was noticed on day 21 of age, i.e. in time when mother's milk was intensively used as a source of nutrition by the young. Development of weight was very similar after weaning. In spite of minimum differences, the group fed experimental feed mixture was at average by 36 g heavier at individual weightings.

Weight gains are very variable in the period before weaning. Rate of gains is almost the same after weaning. No tendency in favour of one of the studied pelleted feeds was observed. Differences in average daily relative gains are not statistically significant ($P = 0.631$). In comparison to the period after weaning, the difference was even lower ($P = 0.967$).

DISCUSSION

Comparison of nutritive value of pelleted feed mixture for hares, which was produced using secondary raw material after oat flake production, with nutritive value of commercially produced pelleted feed mixture for rabbits (BZ-Z), used in this study, with the results of Hell and Slamečka (1999) shows approximately identical values in dry matter content, nitrogen-free extract and ash. The content of crude protein in our feed mixture was

almost at the same level but the content of fat and fibre was higher.

Results of reproduction were recorded only in one litter during the experimental period. Number of young in the experimental group was 3.25 individuals per one female, in the control group were 3.00 individuals. Reproduction of parental pairs in the experimental group out of the period of feeding experiment was 2.81 young and in the control ones - 3.19 young. In the course of the whole calendar year, the average number of young was 2.02 per one litter in the experimental group and 1.66 young in the control group. The results obtained in our experiment correspond to the results reported in the cited works. Hell and Slamečka (1999) and Slamečka et al. (2001) reported the average number of young 2.3 in one litter, Petersen (1990) - 2.5 young and F.L.E.L. (1985) - from 2.2 to 2.5 young.

Number of litters from one female out of the experimental period was at average from 2.50 to 3.00, and from 3.50 to 4.00 for the whole calendar year. Results of Slamečka et al. (1997) and Hell et al. (2006) confirm our results. They reported that an average fertile female brings litters 3-4 times a year and average number of young in a litter is 2.2 - 2.6 individuals. One female brings 8 - 10 young totally during one year. Size of litter varies during the year, what also supports our results. Semizorová and Švarc (1987) reported that a doe-hare could have up to 5 litters a year with respect to length of pregnancy (42 - 43 days).

Sexual activity in hares ended towards the mid of August, as we noticed the last litter in October. The months - October and November are considered as months of reproduction rest in hares. The above mentioned results correspond with the results of Fanta et al. (1984); F.L.E.L. (1985); Kučera (1988); as well as with authors engaged in observation of free living hares (Hell, 1972; Semizorová and Švarc, 1987; Solčiansky, et al., 1990).

An average weight of young hares at the age of 14 days varied from 457 g to 492 g, which corresponds with

Table 4: Composition of pelleted feed mixtures

| | Control mixture C | Experimental mixture FMI |
|--------------------------------------|-------------------|--------------------------|
| Component in % | | |
| Hot-air dried proteinous feedstuffs | 40.00 | 35.10 |
| Sugar beet pulp | 10.00 | - |
| Wheat bran | 6.00 | 15.48 |
| Oat | 13.00 | 14.00 |
| Dried malt sprouts | 5.00 | 12.00 |
| Remnants after oat flakes production | - | 10.00 |
| Sunflower | - | 3.00 |
| Sunflower oil meal | 14.00 | 5.00 |
| Full-fat flaked soya | 7.50 | - |
| Carob | 2.50 | - |
| Beet molasses | - | 3.00 |
| Premix for rabbits * | - | 0.50 |
| Monocalcium phosphate | 0.60 | 0.60 |
| Milled limestone | 0.90 | 0.50 |
| Feeding salt | 0.30 | 0.35 |
| Methionine | 0.20 | 0.20 |
| Lysine | - | 0.15 |
| Mycosorb | - | 0.10 |
| Thyme | - | 0.02 |
| TOTALLY | 100.00 | 100.00 |

Nutrients in original matter (g.kg⁻¹)

| | | |
|-------------------------------|--------|--------|
| Dry matter | 902.69 | 907.95 |
| Crude protein (N x 6,25) | 164.16 | 163.19 |
| Crude fibre | 179.38 | 163.45 |
| Fat | 28.63 | 40.20 |
| Ash | 70.53 | 74.03 |
| Nitrogen-free extract | 460.01 | 467.08 |
| Organic matter | 832.16 | 833.92 |
| Acid detergent fibre (ADF) | 204.68 | 163.45 |
| Neutral detergent fibre (NDF) | 353.91 | 334.87 |
| Starch | 167.66 | 177.66 |
| Total calcium | 10.44 | 5.80 |
| Total phosphorus | 6.21 | 6.76 |
| Magnesium | 2.67 | 1.94 |
| Sodium | 1.79 | 2.17 |
| Potassium | 10.90 | 12.23 |

Nutrients in original matter (mg.kg⁻¹)

| | | |
|-----------|--------|--------|
| Iron | 248.24 | 433.73 |
| Manganese | 156.17 | 94.61 |
| Zinc | 76.71 | 183.22 |
| Copper | 24.25 | 23.32 |
| Lead | 0.09 | 0.18 |
| Cadmium | 0.09 | 0.04 |

*0,5% premix for rabbits contain: vit. A 1 800 000 m.j; vit. D₃ 360 000 m.j; vit. E 8 000 mg; vit. K 300 mg; vit. B₁ 500 mg; Vit. B₂ 1000mg; vit. B₆ 500mg; vit. B₁₂ 3mg; Nicotinic acid 6 000mg; Calcium pantothenate 2 000 mg; Biotin 20mg; Folic acid 350mg; Choline 240 000 mg; Co 200 mg; Cu 4 000 mg; Fe 10 800 mg; I 260mg; Mn 9 300 mg; Zn 10 000 mg; Se 23 mg

Table 5: Nutritive value of residua after oat flake production

| Nutrients (g.kg ⁻¹) | Original matter | Dry matter |
|---------------------------------|-----------------|------------|
| Original dry matter | 889.59 | 1000.00 |
| Crude protein (N x 6,25) | 81.40 | 91.51 |
| Crude fibre | 35.31 | 39.69 |
| Fat | 33.93 | 38.14 |
| Ashl | 15.09 | 16.96 |
| Nitrogen-free extract | 723.86 | 813.70 |
| Organic matter | 874.50 | 983.04 |
| Acid detergent fibre | 47.99 | 53.94 |
| Neutral detergent fibre | 154.15 | 173.28 |
| Starch | 582.66 | 654.97 |
| Total calcium | 1.15 | 1.29 |
| Total phosphorus | 0.82 | 0.92 |
| Magnesium | 0.48 | 0.54 |
| Sodium | 0.06 | 0.07 |
| Potassium | 3.50 | 3.93 |
| Iron (mg.kg ⁻¹) | 46.61 | 52.39 |
| Manganese | 40.20 | 45.19 |
| Zinc | 54.61 | 61.39 |
| Copper | 6.68 | 7.51 |
| Lead | 0.09 | 0.10 |
| Cadmium | 0.02 | 0.02 |

Table 6: Amino acid composition of pelleted feed mixtures

| Parameter | Control mixture (C) | | Experimental mixture (FM I) | |
|---|---------------------|------------|-----------------------------|------------|
| | original matter | dry matter | original matter | dry matter |
| Essential amino acid (g.kg ⁻¹) | | | | |
| Arginine | 10.29 | 11.40 | 8.68 | 9.56 |
| Histidine | 4.55 | 5.04 | 3.46 | 3.81 |
| Isoleucine | 6.41 | 7.10 | 5.44 | 5.99 |
| Leucine | 11.12 | 12.32 | 9.34 | 10.28 |
| Lysine | 7.07 | 7.83 | 7.53 | 8.29 |
| Methionine | 2.99 | 3.31 | 1.90 | 2.09 |
| Phenylalanine | 6.99 | 7.74 | 5.66 | 6.24 |
| Treonine | 6.68 | 7.40 | 5.47 | 6.02 |
| Valine | 8.09 | 8.96 | 7.45 | 8.20 |
| Cystine | 2.12 | 2.35 | 1.08 | 1.19 |
| Totally | 66.31 | 73.45 | 56.01 | 61.67 |
| Replaceable amino acids (g.kg ⁻¹) | | | | |
| Alanine | 7.57 | 8.39 | 6.28 | 6.92 |
| Aspartic acid | 16.01 | 17.74 | 13.52 | 14.89 |
| Glutamic acid | 25.89 | 28.68 | 20.14 | 22.18 |
| Glycine | 8.60 | 9.53 | 6.76 | 7.45 |
| Proline | 11.82 | 13.10 | 10.75 | 11.84 |
| Serine | 7.96 | 8.82 | 5.94 | 6.54 |
| Tyrosine | 3.66 | 4.06 | 3.68 | 4.05 |
| Totally | 81.51 | 88.32 | 67.07 | 73.87 |
| Amino acids totally | 147.82 | 161.77 | 123.08 | 135.54 |

the results reported by Kučera (1988) for young at the age of 14 days (458 g). In our observations, slightly higher weight in young at the age of 28 days, from 925 g to 957 g was recorded compared to the results of the mentioned author, reporting an average weight of hares 813 g at the age of 28 days. At the end of the experiment the weight of young varied from 1510 g to 1550 g at the age of 49 days. These results are comparable to the results of the above mentioned author, reporting live weight 1 200 – 1 500 g in hares at the age of 60 days.

In our experiment, higher daily weight gains in young to weaning 19.7 – 21.9 g were recorded. Daily weight gains after weaning were lower (16.2 – 17.7 g). Pilarska (1969) noticed 11.2 g at the age of 5 – 20 days and 28.5 g - at the age of 21 – 50 days.

CONCLUSION

Test of the pelleted feed mixture with 10 % supplement of secondary raw material after oat flake production confirmed that this mixture is suitable as a complete source of nutrition for brown hare. This feed mixture did not affect reproduction negatively; the course of it was nearly the same as in the control group. Hares accepted the feed mixture readily. In rearing of hares after weaning significant differences in live weight of young at the age of 35, 42 and 49 days were noticed; however, average daily gains were not statistically significant. Based on the obtained results it can be stated that the experimental mixture FM I is suitable for the nutrition of brown hares in cage breeding.

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