EVALUATION OF NUTRITIONAL VALUE OF SELECTED FEEDING PEA SEED VARIETIES (*CICER ARVENSE* L.) FROM GREECE*

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This experiment was realised to investigate the nutrition value of six types of pea seed (*Cicer arvense* L.) from Greece i.e. varieties Kythnos, Tilos, Evros, Kasos, Serifos, Sifnos. We have particularly tried to determine protein effect of these varieties of pea seed on the laboratory rats strain Wistar (n = 36) in a balance study for 7 days. The experimental rats were fed *ad libitum* six types of semipurified diets containing 10% of check pea protein. It was been found out that the variety Serifos keeps the best nutritional value and the other varieties in the main demonstrate optimal appreciation, too. The variety Evros has not the suitable nutritional quality because this one does not express an adequate biological effect on the model laboratory rats than it did at the rest groups.

pea seed; crude protein; nutritional value; laboratory rat; balance study; Greece

INTRODUCTION

The main legumes produced in the EU is pea seed which makes 75% of output of all sorts of legumes. It is particularly produced as a protein component of feeding mixtures for farm animals. About 90% output is exploited as feeding pea (Ministry of Agriculture, 2000). Beyond the EU pea seed is also imported from Canada, The Ukraine, Czech Republic, Hungary and Russia. The price of pea seed depends on soy price which is imported in the EU, too. France, Germany, Great Britain and Denmark are the greatest producers in the EU. There were produced 1,998 thousand ton of pea seed production with an average yield 2.28 t/ha and the mean harvest area covered 4,553 thousand ha in Europe in 2001 (Ministry of Agriculture, 2001).

Pea seed contains enough enzymes, vitamin A, B complex, lecithin and this mainly is important protein source for feeding mixtures. The feeding quality of pea seed is determined by the amount of protein and its amino acid composition, biological quality and digestion. The anti-nutritional content decides about pea utilization in organism, too (Herzig, 1960). Pea seeds are produced usually in temperate regions, but they are accepted as a food source worldwide. Traditionally, non-ruminant diets utilized peas, which had been rejected by the food industry and specific feed (or field) pea seed cultivars also have been developed for livestrain use. In view of the growing season, there is a considerable range in the composition and pea nutritive value (Castell et al., 1996).

Pea seeds are a good nutrition nitrogen and energy donor for cattle, especially for dairy cows. Pea has also an impact on the positive quality of milk fat, prolonged storage butter stability and make better flavour property (Kudrna et al., 1998). Prokop et al. (1991) said that pea has great content of lysine in nitrogen solution and likewise high energy content in dry matter and this fact makes it notable feed for pigs. According to Kováč et al. (1989) it is possible to give pea seeds into the feeding mixtures in amount up to 10% like source of protein for poultry. Worth of pea is found as abort sequence of cereals plant, to enrich nitrogen nutrition of the soil and also to make a good soil structure. Legumes play a new role in the environment, because they are a source of amyloses to produce ecological cover material with short time of their degradation (Hosnedl et al., 1998).

MATERIAL AND METHODS

Animals

Laboratory rat males *Rattus norvegicus* strain Wistar (n = 36) were taken as experimental animals. The animals were from Biotest Konárovice, a.s. They were 21st days old and the weight moved at the range 45 ± 5 g. Zootechnical conditions and animal care followed the principles of the Czech law on the protection of laboratory animals (Statement No. 311/1997 Coll., about laboratory animals housing and using).

Test diets

The laboratory rats were fed by semisynthetic diet. Six types of feed diet were prepared where each of them contained one chick pea seed variety from Greece-Kythnos (KYT), Tilos (TIL), Evros (EVR), Kasos (KAS), Serifos (SER) or Sifnos (SIF). Every mixture consisted of the same amount of chick pea crude protein (10%),

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plant oil (5%) and vitamins and minerals (Aminovitan No. 330 STER, Biofaktory Praha, a.s.) (6%). Corn starch was the final component, which was supplied in all mixtures.

Average crude protein content and another nutrition each chick pea seed variety are presented by Table 1.

Table 1. Nutrition content several check pea seed varieties from Greece

Variety of pea seeds	Nutrition %				
	crude protein	dry matter	ether extract	fiber	ash
Kythnos	21.4	90.2	7.5	2.8	2.3
Tilos	19.5	90.7	7.7	2.5	2.5
Evros	23.8	92.1	4.1	4.3	3.1
Kasos	26.1	92.5	4.0	2.8	3.1
Serifos	18.8	91.7	3.5	5.9	3.1
Sifnos	19.2	92.4	4.6	4.1	3.2

Balance study

The rats were divided into six experimental groups, each group held six model animals. The experimental animals were bred individually in balance cages during the whole study. The adjusted period preceded the main examination part and it took 5 days. The experiment itself period consists of 7 days during which the experimental animals were fed *ad libitum*. The balance experiment was organised according to the method of Kacerovský et al. (1990). We obtained some important data, i.e. average body weight gain (g), average weight (g), feed conversion (g/g), feed intake (g), efficiency N-digestibility (%), faecal N (%), urinary N (%), total N-consumption (g), N-balance (mg), biological value (BV) (%), protein efficiency ratio (PER) (g), net protein utilization calculated (NPU) (%). We also collected excrements and ascertained the total quantum of excluded urine and faeces. The urine was conserved by 5% H_2SO_4. Weight was found out before and after the experimental period.

Statistical analysis

We applied the statistical programme Statgraphic *Plus*, version 3.1. The Analysis of Variance One-Way ANOVA has allowed to detect differences among means for every monitored parameter among each experimental group in our case by Tukey HSD test. The confidence interval was designated $P \leq 0.05$ and $P \leq 0.01$.

RESULTS AND DISCUSSION

In this experiment we tried to determine one or two chick pea seed varieties with the highest nutritional value. Table 2 presents all results from this nutritive study with six varieties of Greek chick pea seeds. There are recorded means, standard deviations and appreciation differences among means in columns.

It can be stated that most of observed zootechnical parameters, i.e. average body weight gain, average weight, feed conversion brought recognition statistical signification difference of EVR and KAS to the other varieties of pea seed. EVR and KAS have demonstrated only slight effect on the model animals. So we can say that the laboratory rats fed by EVR (17.8 ± 5.5) and KAS (18.4 ± 5.5) did not achieve optimal average body weight gain comparing to SER (32.5 ± 4.5) ($P \leq 0.01$). Normal body weight gain of 23–33 days old and 55–110 g weighty male Wistar laboratory rat is average 5.0–5.4 g per day (NRC, 1962). This fact analogously corresponds to evaluation in the case of feed conversion where EVR (4.3 ± 0.9) and KAS (4.3 ± 1.1) were significantly different ($P \leq 0.01$) to the variety SER. There was got the amount 2.7 ± 0.3, which adverts to a good nutrition utilization. Doherty and Keady (2001) in their nutritive study with expander peas noticed the effect of chick pea seed diets on the experimental pigs. These diets have given increasing feed conversion ratio with regard to the control cereal diet, which they used. Furthermore, the animals in the groups fed by EVR (66.0 ± 7.2) and KAS (66.3 ± 8.4) gained considerable lower average weight than it was in the other groups, too. NRC (1962), as had been said, recommends average weight 55–110 g for 23–33 days old male laboratory rats strain Wistar. Sufficient growth disposition were registered after being fed by pea varieties TIL, SER and KYT.

The feed intake did not show any major difference among particular varieties in spite of the fact that the diet with content of EVR (73.3 ± 6.9) and KAS (75.0 ± 7.5) did not indicate significantly the lowest effect on feed intake and the mixture with pea seed KYT (83.7 ± 3.4) and SER (86.2 ± 5.3) did the highest. It is evident, that EVR and KAS did not manifest the appropriate effect on the parameter with regard to other types of pea seed. For example, the ideal daily feed intake is described by NRC (1962) and it says, that standard makes 9–15 g per day for male Wistar laboratory rat 23–33 days old with weight of 55–110 g.

The lowest metabolic nitrogen balance was found by the variety TIL. The value equals to 60.5 ± 25.1 which gave difference form values of EVR, KAS, SER and SIF (P0.01). On the other hand, the variety SER (154.0 ± 17.1) showed relatively high influence on the nitrogen balance of the experimental laboratory rats fed by the mixture with content of chick pea seed variety SER.

KYT (62.2 ± 8.2) and TIL (51.7 ± 12.4) evidently demonstrated their very small biological value ($P \leq 0.01$) with regard to the other pea varieties. So we can notice chick pea seed varieties SER (95.9 ± 5.4) and SIF (94.6 ± 4.4) seem to have the best presumption to be used like feeding component in mixtures for domestic animals, which is supposedly created by their good amino acid composition.

The variety SER proved no statistical significance but sufficient protein equivalent ratio (3.8 ± 0.4) and again this probably possible thanks its composition of amino acid. In comparison to EVR (2.3 ± 0.5) and KAS (2.5 ±

Table 2. Results of comparision among each chick pea seed varieties for selected parameters

Comparation parameter	Unit	Variety of pea seed					
		Kythnos	Tilos	Evros	Kasos	Serifos	Sifnos
		mean ± S.D.					
Average body weight gain	g	26.3 ± 3.2 –	27.7 ± 6.3 3	17.8 ± 5.5 2, 5	18.4 ± 5.5 5	32.5 ± 4.5 3, 4	26.3 ± 6.4 3, 4
Average final weight	g	81.4 ± 1.4 3, 4	83.3 ± 7.9 3, 4	66.0 ± 7.2 1, 2, 5, 6	66.3 ± 8.4 1, 2, 5, 6	82.9 ± 7.2 3, 4	78.7 ± 7.0 3, 4
Feed conversion	g	3.2 ± 0.4 –	3.1 ± 0.5 3, 4	4.3 ± 0.9 2, 5	4.3 ± 1.1 2, 5	2.7 ± 0.3 3	3.2 ± 0.6 –
Feed intake	g	83.7 ± 3.4 –	83.3 ± 8.9 –	73.3 ± 6.9 –	75.0 ± 7.5 –	86.2 ± 5.3 –	80.6 ± 10.3 –
N-consumption	g	0.9 ± 0.2 –	1.0 ± 0.2 –	0.7 ± 0.2 –	0.8 ± 0.3 –	0.5 ± 0.2 –	0.6 ± 0.2 –
N-balance		90.1 ± 18.3 5, 6	60.5 ± 25.1 3, 4, 5, 6	113.4 ± 24.8 2, 5	112.3 ± 22.7 2, 5	154.0 ± 17.1 1, 2, 3	138.6 ± 23.6 1, 2
BV	%	62.2 ± 8.2 3, 4, 5, 6	51.7 ± 12.4 3, 4, 5, 6	88.0 ± 7.0 1, 2	85.3 ± 9.8 1, 2	95.9 ± 5.4 1, 2	94.6 ± 4.4 1, 2
PER		2.9 ± 0.4 –	3.2 ± 0.5 –	2.3 ± 0.5 5	2.5 ± 0.6 5	3.8 ± 0.4 3, 4	3.1 ± 0.5 –
NPU	%	54.0 ± 7.2 3, 4, 5, 6	41.4 ± 9.5 3, 4, 5, 6	72.6 ± 7.9 1, 2	71.1 ± 11.2 1, 2	82.6 ± 5.2 1, 2	80.3 ± 6.4 1, 2
N-digestibility	%	86.8 ± 4.4 –	80.2 ± 2.1 –	82.5 ± 4.4 –	83.1 ± 5.1 –	86.2 ± 3.0 –	84.9 ± 4.9 –
Fecal N	%	1.4 ± 0.4 –	2.0 ± 0.3 –	1.5 ± 0.3 –	1.5 ± 0.4 –	1.5 ± 0.3 –	1.5 ± 0.4 –
Urinary N	%	0.9 ± 0.2 5	1.0 ± 0.2 5, 6	0.7 ± 0.2 –	0.8 ± 0.3 –	0.5 ± 0.2 1, 2	0.6 ± 0.2 2

0.6) pointed out significant decrease in this criterion ($P \leq 0.01$).

In characteristic net protein utilization are demonstrated the lowest values gained ($P \leq 0.01$) by KYT (54.0 ± 7.2) and TIL (41.4 ± 9.5). The highest NPU is demonstrated by the variety SER (82.6 ± 5.2) but this difference had no significant value.

Statistical significant low nitrogen digestibility level was registered by KYT (21.2 ± 6.2) in comparison to the varieties TIL, EVR, SER. Beyond SER (34.1 ± 14.8) keeps satisfactory N-digestibility. Leontowitcz et al. (2001) realized an experiment with extruded legume seeds within pea seeds and tried to establish their effect on functional and morphological parameters on laboratory rats. They found out that extruded pea seeds did not improve the digestibility of protein.

The final point of our study is urinary nitrogen amount. There we can say that the variety KYT (0.9 ± 0.2) demonstrated a lower degree of chick pea protein utilization versus SER ($P \leq 0.05$) and also TIL (1.0 ± 0.2) showed the same tendency, i.e. approved significant difference to the pea seed variety SER (0.5 ± 0.2) and SIF (0.6 ± 0.2) in this attribute.

We did not notice any considerable difference among the varieties of Greek check pea seed in N-consumption, N-digestibility and faecal N. However the differences among varieties in question N-consumption are relatively small. N-consumption was slightly lower by the variety EVR and higher by the variety SER.

CONCLUSION

Although we found out, that the highest substitution of crude protein had the variety Kasos chick pea seed, in the end we can agree with the opinion that in our experimental study the highest nutritional value of Grecian chick pea seed has been brought out by the variety Serifos. The worst nutritive evaluation got the variety Evros as well as Tilos. Other chick pea seed varieties were of indifferent quality and we consider that these, together with Serifos can be incorporated into feeding mixtures for the nutrition of domestic animals as an optimal substitute instead of animal protein. Animal protein production as meat-bone meal is more expensive, more difficult to gain and also not so safe. Beyond the priority of pea seed protein is a suitable amino acid composition close to animal protein.

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Zhodnocení nutriční hodnoty vybraných odrůd cizrny (*Cicer arvense* L.) pocházejících z Řecka.

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V práce je zhodnocena dietetická kvalita vybraných šesti odrůd cizrny (*Cicer arvense* L.) pocházejících z oblasti Řecka. Zaměřili jsme se zejména na determinaci kvality proteinů obsažených v semenech testovaných odrůd prostřednictvím biologické testace. Metodika experimentu vychází z klasických bilančních pokusů prováděných na modelovém organismu, kterým byl v našem případě laboratorní potkan kmene Wistar (n = 36).

Na základě provedených bilančních pokusů se jako nejlepší zdroj bílkovin ukázala řecká odrůda Serifos, neboť na experimentálních zvířatech krmených touto směsí se projevil nejvyšší biologický účinek krmiva. Naproti tomu dieta obsahující cizrnu odrůdy Evros neprokázala příznivý účinek na biologii zvířat. U ostatních odrůd cizrny řecké provenience byl zjištěn nevýrazný efekt.

hrách setý; bílkoviny; nutriční hodnota; laboratorní potkan; bilanční pokus; Řecko

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