BENHA VETERINARY MEDICAL JOURNAL, VOL. 26, NO. 1:178-184, MARCH 2014

DRIED DISTILLER'S GRAINS WITH SOLUBLES (DDGS) INCLUSION AND ALLZYME SSF® SUPPLEMENTATION IN GROWING-FINISHING RABBIT DIETS: 2. IMPACT ON MEAT CHEMICAL COMPOSITION

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A B S T R A C T

The main objectives of this study were to partially substitute corn and soybean meal with dried distiller's grains with solubles (DDGS) and to supply Allzyme SSF® in growing-finishing rabbit diet, investigating the influence of these diets on rabbit's meat quality. Seventy two rabbits of both sexes were randomly assigned in a feeding trial from 54th to 91th day of age, allotted into 6 equal groups (12 rabbits/ group) to evaluate 6 experimental diets varied basically in Allzyme SSF® (0 or 0.02 %) and DDGS (0, 10 or 20 %) levels within 2 x 3 factorial arrangement. Rabbits were fed ad libitum until they attained slaughtering age (91th day). Compared with DDGS-non containing, DDGS-containing diets either with or without Allzyme SSF® supplementation recorded a significant increase in minerals content of rabbit's meat ($P \leq 0.05$). In conclusion, DDGS level up to 20 % as well as Allzyme SSF® supplementation in growing rabbit's diets has no detrimental effect on rabbit's meat composition.

Keywords: Dried distiller's grains with solubles (DDGS), Allzyme SSF®, Growing-finishing rabbits

(BVMJ-26(1):178-184, 2014)

1. INTRODUCTION

Rapid expansion in bio-ethanol industry has led to the production of huge amount of dried distiller's grains with solubles (DDGS; 25 – 30 % CP, 8 – 10 % EE, 4 – 7 % ash, 10.5 % starch and 4 – 12 % CF) as provided by tables of feed ingredients' nutrients chemical composition (NRC, 1977; Maertens et al., 2002; De Blas et al., 2010). DDGS have been extensively introduced to animal's diets as alternative protein source (Hill, 2004). The nutritive value of DDGS (Villamide et al., 1989; De Blas et al., 2010; Alagon et al., 2013a) have been extensively studied while, few studies had been conducted on their effect on rabbit's carcass characteristics and meat quality (Chrastinova et al., 2009; Alagon, 2013). This very limited research on carcass composition in response to DDGS needs scientific evaluation (Lemenager et al., 2006).

Allzyme SSF®, a commercial enzyme complex consists of 7 active enzymes; amylase, beta gluconase, protease, cellulase, pectinase, phytase and xylanase (Adeniji, 2008) produced by Aspergillus niger fungus using solid state fermentation (SSF) technology by Alltech incorporation in USA deserves to be tested to improve the feeding value of DDGS-containing diets for rabbits. To the best of our knowledge, there is no individual study evaluated the effect of

Allzyme SSF® supplementation in growing rabbit's diets containing varying levels of DDGS. Further research on rabbit's meat quality in response to DDGS combined with Allzyme SSF® supplementation is therefore needed to prove that those feed ingredients could replace corn-SBM based diets for rabbits. We hypothesized that Allzyme SSF® supplementation might affect rabbit's meat quality. Therefore, the main objectives of this study were to partially substitute corn and SBM with DDGS, as well as to supply Allzyme SSF® in growing rabbit's diet investigating the influence of those diets on meat quality.

2. MATERIALS AND METHODS

This research study was performed by conducting a rabbit feeding trial from 54th to 91th day of age in which DDGS were incorporated (0, 10 or 20 %) and Allzyme SSF® was supplemented (0 or 0.02 %) in growing-finishing rabbit's diets in 2 x 3 factorial design to evaluate six experimental diets.

2.1. Experimental diets

Feed ingredients were cleaned, weighed, prepared, and thoroughly mixed together to formulate six different experimental diets, then pelleted. Diets were formulated to be iso-nitrogenous, iso-caloric, as well as iso-lignocellulosic using the nutrients content values of feed ingredients described in the nutrients composition tables to achieve the optimum nutrient requirements of rabbits (NRC, 1977). Diets were varied basically in Allzyme SSF® and DDGS levels as follows; T1; 0 % Allzyme SSF®, 0 % DDGS; T2; 0.02 % Allzyme SSF®, 0 % DDGS; T3; 0 % Allzyme SSF®, 10 % DDGS; T4; 0.02 % Allzyme SSF®, 10 % DDGS; T5; 0 % Allzyme SSF®, 20 % DDGS; T6; 0.02 % Allzyme SSF®, 20 % DDGS; respectively (Table 1).

2.2. Experimental animals

Apparently, healthy 72 rabbits of both sexes were used in that feeding trial from 54th to 91th day of age. Rabbits were weaned at 30th, brought at 40th day of age from a reputable source, housed in galvanized cages, which were supplied with food hopper as well as automatic watering system with nipple drinkers. They were left 14 days for acclimatization before the beginning of the experiment. At 52th day of age all animals were fasted for 12 h, weighed, averaged, then were identified by means of ear tags before being divided into six equal groups (twelve rabbits/ group, each group was subdivided in to three replicates; four rabbits/ replicate). The experiment was started at 54th day of age, and rabbits were allowed free choice access to feed and water in an entirely randomized design till the slaughtering age (91th day).

2.3. Proximate chemical analyses:

Chemical analysis of experimental diets was conducted according to the standard methods of AOAC (2000) for; DM by oven drying while moisture was calculated by mass difference (100 – DM %), ash was analyzed by combustion in a muffle furnace, CP (Total N was determined by a micro-Kjeldahl technique; Turbotherm digestion and Vapodest 30 S distillation units, Gerhardet, Germany), CF was determined by Weende method using Fibertech™ 1020 (M6, Foss, Denmark), EE was determined after fat extraction by Soxhelt's method using petroleum ether, and finally NFE % was calculated by mass difference. Frozen lean meat prior to chemical analysis, were thawed, dried at 60 0C for 48 hours; then half of them were continued to be fully dried to determine DM to calculate the moisture % by mass difference and the other half followed the

Table 1. Feed ingredients compositions (%) of the experimental diets

Ingredients	Experimental diets					
	T1	T2	T3	T4	T5	T6
Alfalfa Hay	31.23	31.21	31.23	31.21	31.23	31.21
Wheat Bran	32	32	30	30	28	28
Corn (Yellow)	22	22	19	19	15	15
Soybean Meal	13	13	8	8	4	4
DDGS	0	0	10	10	20	20
◊Allzyme SSF®	0	0.02	0	0.02	0	0.02
Common Salt	0.50	0.50	0.50	0.50	0.50	0.50
Lime Stone	0.50	0.50	0.50	0.50	0.50	0.50
*Vit. & Min. Mix.	0.30	0.30	0.30	0.30	0.30	0.30
Anti-mycotoxin	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Antioxidant	0.05	0.05	0.05	0.05	0.05	0.05
Anti-coccidial	0.02	0.02	0.02	0.02	0.02	0.02
Total	100	100	100	100	100	100

Typical activities in Allzyme SSF® produced by Alltech incorporation USA are; phytase: 1,000 PU/g, protease: 1,200 HUT/g, xylanase: 300 XU/g, cellulase: 250 CMCU/g, β-glucanase: 750 BGU/g, amylase: 25 FAU/g and pectinase: 5 AJDU/g. *Vit. & Min. Mix.: vitamin and mineral mixture produced by AGRI-VET 10th of Ramadan city A2, Egypt, each 3 kg contains: vit. A 12000000 IU, vit. D3 2000000 IU, vit. E 10000 mg, vit. K3 2000 mg, vit. B1 1000 mg, vit. B2 5000 mg, vit. B6 1500 mg, vit. B12 10 mg, biotin 50 mg, pantothenic acid 10000 mg, nicotinic acid 30000 mg, folic acid 1000 mg, manganese 60000 mg, zinc 50000 mg, iron 30000 mg, copper 10000 mg, iodine 1000 mg, selenium 100 mg, cobalt 100 mg, carrier ($CaCo_3$) up to 3 kg.

other half followed the previously described methods of chemical analysis to determine other nutrients.

2.4. Meat chemical composition:

Rabbits were slaughtered when they reached the slaughtering age (91th day). On the day before slaughtering, rabbits were deprived of food for 12 h, and then slaughtered at 18:00 o'clock. After slaughtering, rabbits were de-skinned, eviscerated and dissected into edible and non-edible parts as quickly as possible. For lean composition traits, three carcasses per each group were divided longitudinally into two similar halves; one half-carcasses were dissected from bone and the meat was frozen (–18 °C) until chemical analyses.

2.5. *Statistical analysis:*

The recorded data were analyzed using two-way analysis of variance (ANOVA) as 2 x 3 factorial arrangements (2 Allzyme SSF® x 3 DDGS levels with an interaction model). The individual rabbit was used as the experimental statistical unit. The general linear model (GLM), Univariate of IBM SPSS statistics 19 was used for all analysis. Tukey or Duncan post hoc tests were used for multiple comparisons among the three DDGS levels with a confidence level at ($P \leq 0.05$). The values having the significant interaction between Allzyme SSF® and DDGS were re-analyzed using one-way ANOVA for multiple comparisons among all experimental groups with a confidence level at ($P \leq 0.05$).

3. RESULTS

3.1. *Chemical composition of experimental diets:*

The chemical composition of the experimental diets is shown in Table 2. The analytical composition of the experimental diets for crude fiber was lower (9.5 %) than the expected (12 %).

3.2. *Meat chemical composition:*

The effect of DDGS inclusion and Allzyme SSF® supplementation in rabbit's diet on their meat chemical composition is presented in Table 3. Allzyme SSF® supplementation in T2 significantly increase the DM and EE contents ($P \leq 0.05$) of rabbit's meat compared to Allzyme SSF® non-supplemented group (T1). However, the lower inclusion rate of DDGS significantly increase the EE content of their meat ($P \leq 0.05$) in Allzyme SSF® non-supplemented (T3) compared to Allzyme SSF® supplemented group (T4). DDGS-containing diets either with (T4, and T6) or without (T3 and T5) Allzyme SSF® supplementation recorded a significant increase in minerals content of rabbit's meat ($P \leq 0.05$) compared to DDGS-non containing (T1 and T2) diets reflecting the higher minerals retention in rabbit's meat.

Table 2. Proximate chemical composition of the experimental diets (g/100g as-fed unless otherwise indicated)

Nutrients	Experimental diets					
	T1	T2	T3	T4	T5	T6
Moisture	8.00	9.33	10.00	9.33	10.00	9.33
□DM	92.00	90.67	90.00	90.67	90.00	90.67
□CP	19.12	17.58	18.49	17.32	17.92	17.68
□EE	3.48	3.81	4.53	4.88	6.26	5.41
□CF	9.85	7.93	11.06	9.40	10.30	9.76
Ash	7.42	5.99	7.54	5.64	6.70	7.10
*□NFE	52.00	54.64	47.47	50.19	46.12	49.4
∞DE (kcal/kg DM)	2860	3129	2803	3132	2949	2909

□DM: dry matter, CP: crude protein, EE: ether extract, CF: crude fiber, NFE: nitrogen free extract *NFE%: calculated by difference ∞DE (kcal/kg DM): calculated by the following equation; 4253 - 32.60 (CF%) - 144.40 (ash%) according to Fekete and Gippert (1986).

Table 3. Effect of DDGS inclusion and Allzyme SSF® supplementation in rabbit's diet on their meat chemical composition

*A level	0%			0.02%			MSE	P value		
DDGS level	0%	10%	20%	0%	10%	20%		*A	DDGS	*A x DDGS
Experimental diets	T1	T3	T5	T2	T4	T6				
Nutrients (%)										
Moisture	77.33^{a}	72.13^{ab}	75.10^{a}	68.83^{b}	75.07^{a}	75.30^{a}	1.790	0.245	0.489	0.020
□DM	22.67^{b}	27.87^{ab}	24.90^{b}	31.17^{a}	24.93^{b}	24.70^{b}	1.790	0.245	0.489	0.020
□CP	5.93	6.15	6.67	7.80	6.39	6.45	0.508	0.157	0.525	0.140
□EE	5.23^{b}	11.21^{a}	4.25^{b}	11.90^{a}	6.71^{b}	4.83^{b}	1.116	0.334	0.003	0.001
Ash	3.23	5.09	5.12	3.15	5.00	4.70	0.550	0.663	0.010	0.941
◊□NFE	8.28	5.33	8.96	8.40	6.99	8.74	1.314	0.635	0.136	0.752

^{a,b}Means with different letters superscripts at the same row differ significantly at ($P \leq 0.05$). *A; Allzyme SSF®
□DM: dry matter, CP: crude protein, EE: ether extract, NFE: nitrogen free extract. ◊NFE %: calculated by mass difference.

4. DISCUSSION

Experimental diets Experimental diets were formulated to be iso-nitrogenous, iso-caloric, as well as iso-lignocellulosic in terms of protein, energy, and crude fiber content, respectively. The chemical analysis of the experimental diets revealed that there were some differences between the expected and the analytical compositions for crude fiber content. These differences most probably attributed to either the lower fiber content derived from alfalfa hay and wheat bran or our inability to analyze these two ingredients. These current results indicated that DDGS inclusion in growing-finishing rabbit's diets hardly affect the meat quality in terms of chemical composition consistent with previous studies (Alagon, 2013; Dong et al., 1990). With regard to enzymes supplementation, our results for meat characteristics were nearly consistent with those of Olayemi et al. (2006) who noticed that rabbits fed control and 12 % maize milling waste (MMW) inclusion level had similar carcass characteristics either with or without xylanaze supplementation.

Conclusion

We can concluded that, the higher mineral, nevertheless its normal protein and fat content of rabbit's meat in diets containing DDGS indicated that DDGS added minerals value to the metabolic pool for rabbits. The inclusion of DDGS up to 20 % of the total rabbit's diet has no detrimental effect on rabbit's meat quality and could be used as an alternative ingredient to SBM and corn.

Acknowledgement

This trial could not proceed without the active cooperation of many persons from Egypt, USA, and Belgium to whom I am deeply obliged. I wish to express my gratitude to them for their continuous help and support.

5. REFERENCES

Adeniji, A.A. 2008. Replacement value of maize with enzyme supplemented decomposed bovine rumen content in the diets of weaner rabbits. Asian Journal of Animal and Veterinary Advances 3(2): 104-108.

Alagon, G. 2013. Use of barley, wheat, and corn distiller's dried grains with solubles in diets for growing rabbits: nutritive value, growth performance and meat quality. Doctor of Philosophy Dissertation, Department of Animal Science, Polytechnic University of Valencia.

Alagon, G., Arce O.N., Martinez-Paredes, E., Rodenas, L., Moya, J.V., Pascual, J.J., Cervera, C. 2013a. Nutritive value of distiller's dried grains with solubles from barley, corn, and wheat for growing rabbits. Animal Feed Science and Technology, cited in: Alagon, G. (2013), Use of barley, wheat, and corn distiller's dried grains with solubles in diets for growing rabbits: nutritive value, growth performance and meat quality. Doctor of Philosophy Dissertation, Department of Animal Science, Polytechnic University of Valencia.

AOAC, 2000. Official Method of Analysis (17th Eds.). Association of Official Analytical Chemists, Washington, D.C., USA.

Chrastinova, L., Chrenkova, M., Polacikova, M., Ondruska, L., Formelova, Z. 2009. Application of agricultural by-products in fattening of rabbits. In Proceeding: XIII Symposium "Feed Technology", Serbia, Novi Sad, September 29th – October 1st, 2009.

De Blas, C., Mateos, G.G., Garcia-Rebollar, P. 2010. Tablas FEDNA de la composicion y valor nutritive de alimentos para la fabricacion de piensos compuestos. Tercera edicion, Madrid.

Dong, F.M., Rasco, B.A., Gazzaz, S.S., San Buenaventura, M.L., Holcomb, L.M. 1990. Body composition and serum and liver lipids in rats fed distiller's dried grains. Journal of Food Science and Agriculture, 51: 299-308.

Fekete, S., Gippert, T. 1986. Digestibility and nutritive value of nineteen important rabbit feedstuffs. Journal of Applied Rabbit Research, 9: 103-108.

Hill, D.A. 2004. Alternative proteins in companion animal nutrition. Presented at Pet Food Association of Canada Fall Conf., Toronto, Ontario. Oct. 27, 2004, electronic version at: http://www.ddgs.umn.edu/prod/groups/cfans/@pub/@cfans/@ddgs/documents/asset/cfans_asset_412249.pdf.

Lemenager, R., Applegate, T., Claeys, M., Donkin, S., Johnson, T., Lake, S., Neary, M., Radcliffe, S., Richert, B., Schinckel, A., Schutz, M., Sutton, A. 2006. The value of distiller's grains as a livestock feed. Purdue Extension 12/2006, electronic version available online at: http://www.extension.purdue.edu/extmedia/ID/ID-330.pdf.

Maertens, L., Perez, J.M., Villamide, M., Cervera, C., Gidenne, T., Xiccato, G. 2002. Nutritive value of raw materials for rabbits: EGRAN Tables 2002. World Rabbit Science, 10(4): 157-166.

NRC, 1977. Nutrient Requirements of Rabbits, Second Revised Edition, 1977. Committee on Animal Nutrition, National Research Council, National academy of Science, Washington, D.C., USA.

Olayemi, W.A., Oso, A.O., Bamgbose, A.M., Oduguwa, O.O., Ondeko, S.A. 2006. Response of weaner rabbits to xylanase enzyme supplemented maize milling waste based diets. Journal of Animal and Veterinary Advances 5 (10): 839-843.

Villamide, M.J., De Blas, J.C., Carabano, R. 1989. Nutritive value of cereal by-products for rabbits: 2. Wheat bran, corn gluten feed and dried distiller's grains with solubles. Journal of Applied Rabbits Research, 12, 152-155.

إدراج نواتج تقطير الذرة المجففة والذوائب واضافة مركب الانزيمات في علائق الأرانب النامية-الناهية: التأثير على جودة اللحم.

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الملخص العربي

كانت الأهداف الرئيسية لهذه الدراسة هى الاحلال الجزئي للذرة وكسب فول الصويا بنواتج تقطير الذرة المجففة والذوائب (DDGS) وكذلك اضافة مركب الانزيمات (Allzyme SSF®) في علائق الأرانب النامية–الناهية لدراسة تأثير هذه العلائق على جودة اللحم. نفذت تجربة غذائية للأرانب باستخدام ٧٢ أرنب من كلا الجنسين، قسمت الى ست مجموعات متساوية (١٢ أرنب/مجموعة) فى نظام عشوائى متكامل لتقييم ست علائق تجريبية اختلفت فى محتوى نواتج تقطير الذرة المجففة والذوائب (٠ ، ١٠ ، ٢٠ %) و الانزيمات (٠ ، ٠،٠٢ %) في تصميم عوامل (٢ x ٣) بدءا من اليوم ٥٤ وحتى اليوم ٩١ (عمر الذبح). سمح للارانب لتناول الغذاء والماء بحرية كاملة أثناء التجربة. من حيث التركيب الكيميائي كانت هناك زيادة فى محتوى اللحم من الاملاح للعلائق المحتوية مقارنا بالغير محتوية على نواتج تقطير الذرة المجففة والذوائب. نستخلص من نتائج هذه التجربه، أن ادراج نواتج تقطير الذرة المجففة والذوائب حتى نسبة٢٠٪ وكذلك اضافة الانزيمات لعلائق الارانب لم يؤثر سلبا على جودة اللحم.

(مجلة بنها للعلوم الطبية البيطرية: عدد 26(1):178-184, مارس 2014)