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DRIED DISTILLER'S GRAINS WITH SOLUBLES (DDGS) INCLUSION AND ALLZYME SSF® SUPPLEMENTATION IN GROWING-FINISHING RABBIT DIETS: IMPACT ON GROWTH PERFORMANCE

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ABSTRACT

The main objectives of this study were the partial substitution of corn and soybean meal with dried distiller's grains with solubles (DDGS) and Allzyme SSF® supplementation in growing-finishing rabbit diets studying the effect of these diets on rabbit's performance. The feeding trial was performed on 72 rabbits of both sexes, equally allotted into six equal groups (12 rabbit/ group) in a complete randomized design to evaluate six experimental diets varied basically in the levels of enzymatic complex supplementation (0 or 0.02 %) and DDGS inclusion (0, 10, or 20 %) in 2 x 3 factorial design. Rabbits were allowed free choice access to feed and water from 54th till 91th day (slaughtering age). No statistical significant difference was found for average weight gain (AWG) ($P \geq 0.05$), while high significant increase in average feed intake (AFI) ($P \leq 0.05$) observed in DDGS-containing compared to DDGS-non containing diets. No significant difference was recorded for average feed conversion ratio (AFCR) ($P \geq 0.05$) among all diets except for the higher DDGS inclusion rate without Allzyme SSF® supplementation the AFCR was significantly impaired ($P \leq 0.05$) compared to DDGS-non containing diet. In conclusion, rabbits fed on DDGS-containing diets in this trial consumed significantly more food relative to their final body weight gain, resulting in lowered feed efficiency.

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

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1. INTRODUCTION

Recently, the spread of bio-ethanol industry has resulted in higher market prices for corn based feed (AbuGhazaleh et al., 2011) accompanied with more production of distiller's grains (DG) by-products such as dried distiller's grains with solubles (DDGS; 25 – 30 % CP, 8 – 10 % EE, 4 – 7 % ash, 10.5 % starch and 4 –12 % CF) as described in the nutrients chemical composition tables of feed ingredients (NRC, 1977; Maertens et al., 2002; De Blas et al., 2010) has been extensively incorporated in animal and rabbit diets (Hill, 2004; Shurson, 2006; Petkova et al., 2011a,b). The higher nutritional value (Villamide et al., 1989; De Blas et al., 2010; Alagon et al., 2013a) and the lower price (Petkova et al., 2011b) of DDGS deserve to be tested in rabbit's diet.

On the other hand, exogenous enzymes introduced in to animal's diet as natural alternative products to complement the

endogenous enzymatic capability increasing the nutritive value of the feed (Piquer, 1996; Cachaldora et al., 2004). A naturally occurring multi-enzyme complex (Allzyme SSF®) consists of 7 active enzymes; amylase, beta gluconase, protease, cellulase, pectinase, phytase and xylanase (Adeniji, 2008), produced by Aspergillus niger using solid state fermentation (SSF) technology by Alltech incorporation in USA available in the feed market deserves to be tested in commercial rabbit's feed.

The effect of DDGS inclusion in rabbit's diet on their performance has been extensively studied (Villamide et al., 1989; Chrastinova et al., 2009; Petkova et al., 2011b; Alagon et al., 2013b) while, there is no single study evaluated the effect of both Allzyme SSF® supplementation and DDGS inclusion in rabbit's diet on their performance and meat yield. Therefore, the main objectives of this study were to partially substitute corn and SBM with DDGS as well as Allzyme SSF® supplementation in growing-finishing rabbit's diet investigating the influence of these diets on rabbit's growth performance.

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 weaned at 30th of age, 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 presented as an average initial body weight (AIBW), 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). Experiment was started at 54th day of age, and rabbits were allowed for free choice access to feed and water (ad libitum) in an entirely randomized design until 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

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 (CaCo3) up to 3 kg.

was determined after fat extraction by Soxhelt's method using petroleum ether, and finally NFE % was calculated by mass difference.

2.4. Rabbit's growth performance:

From the beginning of the experiment (54th day) till slaughtering (91th day) of age, the following records were routinely registered; amount offered and rejected feed, to calculate the average feed intake (AFI) per animal, weekly rabbit's weight per cage, to calculate the average weight and then the average weight gain (AWG) per rabbit, average feed conversion ratio (AFCR) was calculated dividing AFI by AWG.

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 experimental diets is presented in Table 2. Crude fiber content of the experimental diets failed to achieve the desired requirement (12 % CF) for the growing rabbits according to NRC (1977).

3.2. Rabbit's growth performance:

The effect of DDGS inclusion and Allzyme SSF® supplementation in rabbit's diet on their growth performance is presented in Table 3. Incorporation of DDGS in rabbit's diet has a little impact on their growth performance. Neither DDGS inclusion nor Allzyme SSF® supplementation to the growing rabbit's diets had influenced their weight gain ($P \geq 0.05$). Inclusion of DDGS in the growing-finishing rabbit diets resulted in a significant increase in AFI (14.37%) in DDGS-containing compared to DDGS-non containing diets ($P \leq 0.05$). The higher inclusion rate of DDGS (20 %) in T5 had significantly impaired AFCR ($P \leq 0.05$) compared to DDGS-non containing diets.

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 growth performance

*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				
Growth performance										
◊AIBW (g)	1275	1259	1250	1275	1255	1254	58.146	0.998	0.917	0.998
◊AFBW (g)	2254	2217	2159	2213	2196	2271	60.616	0.744	0.902	0.414
◊AWG (g/day)	27.97	27.37	25.93	26.81	26.93	29.02	1.562	0.703	0.977	0.378
◊AFI (g/day)	118.00	132.33	139.67	121.53	140.93	135.00	3.835	0.442	0.001	0.257
◊AFCR (g/g)	4.23^{b}	4.86^{ab}	5.49^{a}	4.54^{ab}	5.24^{ab}	4.65^{ab}	0.227	0.801	0.016	0.034

^{a,b}Means with different letters superscripts at the same row differ significantly at ($P \leq 0.05$). *A; Allzyme SSF® ◊AIBW; average initial body weight, AFBW; average final body weight, AWG; average weight gain, AFI; average feed intake, AFCR; average feed conversion ratio.

4. DISCUSSION

Although the experimental diets were formulated to be iso-nitrogenous, iso-caloric, as well as iso-lignocellulosic the lower crude fiber content of the experimental diets (9.5 %) than the desired requirement (12 % CF) for the growing rabbits might be attributed not only to the lower fiber content of both alfalfa hay and wheat bran but also to our inability to analyze those feed ingredients prior to diet formulation. Our results confirmed previous results for Garcia-Ruiz et al. (2006) who found that enzymes (protease + xylanase) supplementation didn't affect the daily gain during the fattening period of rabbits. In our study, the significant increase in AFI for DDGS-containing compared to DDGS-non containing diets ($P \leq 0.05$) was consistent with the previous findings of Shurson, (2007). Rabbits fed on DDGS-containing diets consumed significantly more food relative to their final body weight gain, resulting in lowered feed efficiency as recorded by Dong et al. (1990). On the contrary, Garcia-Ruiz et al. (2006) found that enzymes (protease and xylanase) supplementation didn't affect feed intake and feed conversion during the fattening period of rabbits.

Conclusion

DDGS inclusion up to 20 % of the total diets for growing-finishing rabbits didn't impair weight gain, increased AFI, and increased AFCR while, Allzyme SSF® supplementation to the growing rabbit's diets didn't affect their performance.

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إدراج نواتج تقطير الذرة المجففة والذوائب واضافة مركب الانزيمات في علائق الأرانب النامية-الناهية: التأثير على معدلات اداء النمو

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الملخص العربي

كانت الأهداف الرئيسية لهذه الدراسة هي استبدال جزئي للذرة وكسب فول الصويا بنواتج تقطير الذرة المجففة والذوائب (DDGS) وكذلك اضافة مركب الانزيمات (Allzyme SSF®) لدراسة تأثير هذه العلائق على معدلات اداء النمو. نفذت تجربة غذائية للأرانب باستخدام ٧٢ أرنب من كلا الجنسين، قسمت الى ست مجموعات متساوية (١٢ أرنب/مجموعة) فى نظام عشوائي متكامل لتقييم ست علائق احتوت على نواتج تقطير الذرة المجففة والذوائب بثلاث تركيزات مختلفة (٠ ، ١٠ ، ٢٠ %) و الانزيمات بتركيزين مختلفيين (٠ ، ٠٢، ٠ %) في علائق الأرانب النامية–الناهية في تصميم عوامل (٢ x ٣). كما سمح للأرانب لتناول الغذاء والماء بحرية كاملة بدءا من اليوم ٥٤ وحتى اليوم ٩١ (عمر الذبح). لم يؤثر إدراج نواتج تقطير الذرة المجففة والذوائب وإضافة مركب الانزيمات على وزن الارانب المكتسب، بينما سجلت الارانب التي غذيت على العلائق المحتوية مقارنا بالغير محتوية على نواتج تقطير الذرة المجففة والذوائب فارق معنوي فى معدل تناول الغذاء. لم يكن هناك فروق معنوية فى معدلات تحويل الغذاء بين جميع المجموعات التي تم اختبارها ما عدا المجموعة المحتوية على النسبة الاعلى (٢٠٪) من نواتج تقطير الذرة المجففة والذوائب بدون انزيمات مضافة والتي سجلت اسوء معدل لتحويل الغذاء مقارنا بالمجموعات الغير محتوية على نواتج تقطير الذرة المجففة والذوائب. نستخلص من نتائج هذه التجربة، أن الارانب التي غذيت على نواتج تقطير الذرة المجففة والذوائب سجلت اعلى معدلات تناول الغذاء بالنسبة للوزن النهائي المكتسب مما أدى إلى انخفاض الكفاءة الغذائية (معدل سيء لتحويل الغذاء) مقارنا بالمجموعات الغير محتوية على نواتج تقطير الذرة المجففة والذوائب.

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