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PERFORMANCE OF MUSCOVY DUCKLINGS FED ENERGY DILUTED DIET AND YEAST CULTURE

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ABSTRACT

One hundred and twenty unsexed one-day old Muscovy ducklings were distributed into four equal groups each of 3 replicates (10 birds/replicate). Ducklings were fed on starter diets during the first 14 days post hatching followed by grower diets till the end of the experiment. Starter and grower diets differed in energy level and added Yeast culture (YC) to form 4 dietary treatments being diet 1 (control), containing adequate-energy levels (approximately 2940 and 3040 kcal ME/kg during the starter and grower periods, respectively). Diet 2 was as diet 1 but with addition of YC. Diet 3 has diluted-energy levels (approximately 2700 and 2480 kcal ME/kg during the starter and grower periods, respectively). Diet 4 was as diet 3 but with addition of YC.

Results indicated that body weight (BW) and body weight gain (BWG) were decreased during most age intervals by feeding the diluted-energy diet with insignificant increases occurred with addition of YC, but final BW was still lower compared to the control. Addition of YC to the adequate-energy diet increased BW and BWG during the early age but had no effect thereafter. Feed intake (FI) was increased by feeding the diluted-energy diet with further increase observed with addition of YC. However, such increases cannot maintain energy intake similar to the control. Addition of YC to the adequate-energy diet did not affect FI. Ducklings fed on the diluted-energy diet with or without YC were less efficient in converting feed into gain. Addition of YC to the adequate-energy diet improved feed conversion during the early age but not thereafter. However, dilution of dietary energy either with or without YC and also inclusion of YC in the adequate-energy diet resulted in better efficiency of energy utilization compared to the control. Edible and inedible parts, eviscerated carcass and visceral and pad fats were decreased with feeding the diluted-energy diet with further decreases occurred due to addition of YC. Addition of YC to the adequate-energy diet caused insignificant increase in eviscerated carcass with small decrease in visceral and pad fats. Decreasing dietary energy had no effect on meat crude protein, while it decreased its fat. Addition of YC to the adequate-energy diet significantly decreased meat fat.

It is concluded that diluting dietary energy of Muscovy ducklings achieved desired reduction in carcass fatness but it decreased carcass yield and negatively affected economic efficiency. Addition of YC to such diluted diet caused further decrease in carcass fatness with small increase in carcass yield without improving economic efficiency. Addition of YC to adequate-energy diet caused a slight increase in carcass yield with a small decrease in carcass fatness without affecting economic efficiency.
Keywords: Ducklings, energy dilution, yeast, performance, carcass

INTRODUCTION

The duckling for all metabolic functions, including growth and thermal regulation, needs energy. Scott and Dean (1991) reported that ducks had a propensity to become fat having excellent efficiency of converting carbohydrates to body fat. But, the deposition of fat in carcass of ducklings, particularly in abdominal and visceral areas, is a non-profitable conversion of dietary energy. Moreover, Koh and Macleod (1999) reported that total energy retention and energy retention as fat significantly increased with increasing environmental temperature ranging from 17C to 32C. Furthermore, to optimize growth rate and feed utilization, there is also an ongoing demand to maximize growth of lean tissue and to minimize development of excess accumulation of body and carcass fat at marketing age. Leeson *et al.* (1992) assumed that the broiler could not physically eat more feed than occurs normally, and that diet dilution would then result in reduced energy intake. Such diluted diets did result in reduced energy intake by these birds. So, there seem to be some potential to achieve the desired characteristics of growth and carcass composition of ducklings through limiting energy intake.

Yeast (*Saccharomyces cerevisiae*) culture is rich in protein, energy and many essential amino acids particularly lysine. Therefore, it could be serve as a complementary ingredient. Furthermore, yeast culture, which has undergone controlled fermentation, contains large amounts of the yeast metabolites with some viable yeast cells, which are principal functional components of this type of cultures used as probiotics (Miles and Bootwella, 1991). Such components of yeast culture inhibit harmful bacteria, alter microbial metabolism and decrease intestinal pH and so can be used as probiotics which can enhance poultry production (Makled, 1991; Miles and Bootwella, 1991). However, the utilization of such yeast cultures is varied among poultry species (Savage and Mirosh, 1990a).

Therefore, the purpose of this study was to investigate the effect of energy dilution of summer diets along with addition of a yeast culture (Diamond V "XP") on the performance and carcass fatness of Muscovy ducklings.

MATERIALS AND METHODS

This experiment was carried out at experimental farms of Faculty of Agriculture, Cairo University, Giza, Egypt during summer of the year 1998 (5 June till 28 August). One hundred and twenty unsexed one-day old Muscovy ducklings were distributed into four equal groups each of 3 replicates (10 birds/replicate). Ducklings were fed on starter diets approximately 22% CP during the first 14 days post hatching followed by grower diets approximately 18% CP from day 15 till the end of the experiment (12 weeks). Starter and grower diets differed in energy level and Yeast culture (YC) addition to form 4 dietary treatments being diet 1 (control), containing adequate energy levels, approximately 2940 and 3040 kcal ME/kg for the starter and grower periods, respectively. Diet 2 was as diet 1 but with addition of 0.50 and 0.25% YC during the starter and grower periods, respectively. Diet 3 was formed by diluting energy levels of the control through increasing the percentage of wheat bran to reduce energy levels by 205 and 559 kcal ME/kg for the starter and grower periods, respectively i. e. energy levels became approximately 2700 and 2480 kcal ME/kg for the two periods, respectively. Diet 4 was as diet 3 but with addition of 0.50 and 0.25% YC during the starter and grower periods, respectively. Yeast culture was added according to the recommendations of the supplier. It was a dried product, produced by Diamond V Mills, USA, known commercially as Diamond V "XP" yeast culture which according to the manufacturer, composed of yeast (*Saccharomyces cerevisiae*, about 500 x 10^6 live cells / g) and the media on which it was grown (ground yellow corn, homing feed, corn gluten feed, wheat middling, rye middling, diastatic malt, corn syrup and cane molasses) and other vitamins, amino acids and minerals due to fermentation.

Diets and water were offered *ad libitum* throughout the experimental period. All diets were formulated to meet the nutrient requirements of ducklings, excepting the diluted-energy diets, according to NRC (1994). Percentage composition of the starter and grower diets is shown in Table 1.

During the brooding stage (the first ten days of age), the ambient temperature was artificially maintained around 32 °C. After the brooding stage, ducklings were reared under the natural environmental temperature. All ducklings were exposed to 23-hour lightness and 1-hour darkness starting day 1 till the end of the experiment.

Each duckling was weighed at the start of the experiment and biweekly thereafter till the end of the experiment. Feed refusals of each replicate were also recorded biweekly to calculate feed intake. Energy intake was calculated using the ME values of starter and grower diets (feed intake x kcal ME). Cumulative feed and energy conversions (gram feed or kcal consumed /gram gain) were calculated in 2-weeks intervals.

At the final day of the experiment, four birds from each group (two males and two females) were randomly chosen and slaughtered to determine the absolute weights and percentages of inedible and edible parts, giblets, eviscerated carcass and pad and visceral fats. All meat muscle of one side of each carcass was excised and hashed, then meat samples were taken and chemically analyzed for moisture, crude protein, ether extract and ash. Proximate analysis of feed and fresh meat was done according to AOAC methods (1995).

The data of growth performance (within each time period), carcass characteristics and chemical analysis of meat were analyzed as one-way analysis of variance according to Neter *et al.* (1985) using SAS (1996). Differences among means were evaluated using Duncan's multiple range test (Duncan, 1955).

Table 1. Percentage composition and analysis of the starter and grower experimental diets

Ingredient, %	Starter diets				Grower diets			
	Adequate energy		Diluted energy		Adequate energy		Diluted energy	
	Without YC (control)	With YC	Without YC	With YC	Without YC (control)	With YC	Without YC	With YC
Yellow corn	64.20	64.20	54.20	54.20	73.20	73.20	48.20	48.20
Soybean meal, 44%	25.00	24.50	25.00	24.50	16.00	15.75	11.00	10.75
Wheat bran	-	-	10.00	10.00	-	-	30.00	30.00
Broiler concentrate [1]	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Yeast culture [2]	-	0.50	-	0.50	-	0.25	-	0.25
Limestone	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vit. & min. premix [3]	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Methionine	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Total	100	100	100	100	100	100	100	100
Chemical analysis								
Moisture, %	9.72	9.98	10.35	10.47	9.40	11.85	9.59	11.58
Crude protein, %	22.32	22.38	22.11	22.48	18.67	18.38	18.40	18.25
Ether extract, %	1.67	2.59	1.27	2.43	2.68	2.00	2.09	2.79
Crude fiber, %	3.50	3.60	4.69	4.73	3.80	3.43	6.00	5.83
Ash, %	7.37	6.92	6.77	5.54	5.98	5.20	5.63	5.98
Nitrogen free extract, %	55.42	54.53	54.81	54.35	59.47	59.14	58.29	55.57
Calculated analysis [4]								
Energy, Kcal ME / kg	2942	2947	2737	2742	3043	3045	2484	2486
Calcium, %	0.90	0.90	0.91	0.91	0.88	0.88	0.90	0.90
A. Phosphorus, %	0.42	0.42	0.43	0.43	0.40	0.40	0.42	0.43
Lysine, %	1.22	1.11	1.25	1.20	1.00	0.99	0.98	0.98
Methionine, %	0.56	0.57	0.57	0.57	0.53	0.53	0.52	0.52

[1] Contained 52% crude protein, 3 % crude fiber, 7% calcium, 3% available phosphorus, 3.27% lysine, 1.48% methionine, and 2342 kcal metabolizable energy.

[2] Contained 12% crude protein, 6.5 % crude fiber, 3% ether extract, 3% ash, 65% nitrogen free extract and 3100 kcal metabolizable energy.

[3] Supplied the following per kilogram of diet: Vitamin A 12,000 IU; vitamin D_3 2,000 IU; vitamin E 10 mg; vitamin K 2 mg; vitamin B_1 1 mg; vitamin B_2 4 mg; vitamin B_6 1.5 mg; vitamin B_{12} 10 mcg; Biotin 50 mcg; Niacin 20 mg; Pantothenic acid 10 mg; Folic acid 1 mg; Selenium 0.1 mg; Choline Chloride 500 mg; Copper 10 mg; Iodine 1 mg; Iron 30 mg; Manganese 55 mg and Zinc 50 mg.

[4] According to NRC (1994).

RESULTS AND DISCUSSION

Growth performance

The data of growth of Muscovy ducklings are shown in Table 2. Body weight (BW) and body weight gain (BWG) were decreased during most age intervals by feeding ducklings on the diluted-energy diet, compared to the control. These decreases in BW and BWG reached significant values at the 8th week and during 4-6 weeks, respectively. Furthermore, addition of YC to the diluted-energy diet resulted in insignificant improvements in each of BW and BWG compared to the diluted-energy diet. But with such small improvements, final BW did not reach those of ducklings fed the adequate-energy diet. On the other hand, addition of YC to the adequate energy diet resulted in significant increases in BW and BWG during the early age (first 2 weeks) but had no significant effect thereafter. In agreement with the present results, Dai *et al.*, (1999) fed Shaoxing ducks from 20 to 49 week of age on different dietary energy levels reporting that ducks fed on high (2800 kcal/kg) or medium (2700 kcal/kg) energy levels had higher weights at the ages of 27, 35 and 43 weeks than those fed on low-energy level (2600 kcal/kg). Also, in accordance with the present results, White (1992) found that Rouen ducklings receiving Diamond V yeast culture gained 12.9% more weight than the control during a 34-day study. Kumprechtova *et al.* (2000) found that yeast (*Saccharomyces cerevisiae*) insignificantly improved fiber digestibility and increased N retention of broilers. However, Ragland *et al.* (1998) fed male Pekin ducks on a yeast fermentation product reporting that such product had poor ability to support N retention.

Table (2): Effect of energy dilution with or without yeast culture on growth of Muscovy ducklings

Item	Adequate energy		Diluted energy	
	Without YC (control)	With YC	Without YC	With YC
Age in weeks		Body weight, g		
Zero	50±0.77	51±0.95	52±1.1	50±1.0
2	349^{b}±11	396^{a}±10	364^{b}±12	362^{b}±12
4	1201±51	1235±49	1156±39	1170±40
6	1926±73	1888±72	1778±57	1831±66
8	2657^{a}±107	2588^{ab}±120	2375^{b}±94	2431^{ab}±91
10	3084±162	3071±169	2797±124	2844±137
12	3500±206	3592±230	3228±161	3242±177
Age intervals in weeks		Body weigh gain, g		
0-2	299^{b}±10	345^{a}±10	312^{b}±12	312^{b}±12
2-4	852±45	839±40	792±36	808±30
4-6	725^{a}±50	653^{ab}±27	622^{b}±26	661^{ab}±36
6-8	731±54	700±58	597±54	600±40
8-10	428±63	483±71	422±67	413±54
10-12	415±53	521±72	431±79	398±47
0-12	3449±206	3543±230	3176±161	3193±177

Means in the same row without superscripts are not significantly different ($p > 0.05$), while those having different superscripts differ significantly ($p \leq 0.05$).

The data of feed intake and feed conversion of Muscovy ducklings are shown in Table 3. Ducklings fed the diluted-energy diet consumed more feed during all age intervals and addition of YC to this diluted-energy diet resulted in further increase in feed intake (FI) compared to the control. Differences in FI between the two groups and those of the control were significant. Moreover, addition of YC to the adequate-energy diet had no significant effect on FI. However, energy intake (kcal ME) of ducklings fed on the diluted-energy diet either with or without YC was significantly lower than that of the control despite of the significant increase in FI. In fact, the increase in FI of these low-energy diets was not sufficient to maintain energy intake. Addition of YC to the adequate-energy diet had no significant effect on energy intake. Ducklings fed on the diluted-energy diet with or without YC were less efficient in converting the consumed feed into gain during all age intervals and also as overall mean compared to those fed the adequate energy diets. Differences were significant during 4-6 weeks of age. But addition of YC to the adequate-energy diet significantly improved feed conversion during the early age (0-2 weeks) but had no significant effect thereafter. However, dilution of dietary energy either with or without addition of YC and also inclusion of YC in the adequate-energy diet resulted in better energy conversion values than those of the control. The improvement due to YC addition to the adequate-energy diet was significant at the early age (0-2 weeks). Such higher efficiency in converting dietary energy to body weight of ducklings on the diluted-energy diets may be due to the tendency of these ducklings to deposit less fat in their carcasses (Tables 4&5). Fatty tissue is more concentrated in its energy than protein of meat. Similarly, Lesson *et al.* (1996a) found that broiler chickens fed on low-energy diets were much more efficient in converting energy to body weight gain than those fed on high-energy diets. Furthermore, the increase in feed intake of ducklings on the diluted-energy diet may be due to the high ability of ducks to increase feed intake and adapt to maintain a near normal weight gain when fed low-energy diets (Dean, 1978). In accordance with the present results, Dai *et al.* (1999) found that feed intake of ducks offered medium-energy diet (2700 kcal/kg) during a study period from 20 to 49 week of age was higher than those on a high-energy diet (2800 kcal/kg). However, they found that ducks on the medium-energy level consumed more feed than those on the low-energy level (2600 kcal/kg) in the early period. Moreover, Kassim and Suwanpradit (1996) and Zanusso *et al.* (1999) found that ME intake of broilers increased when ME of the diet increased. In addition, Miraei *et al.* (1999) reported that broilers could not maintain energy requirements by changing feed intake levels when fed on low-energy diets.

The present results also agree with those of Ibrahim *et al.* (1997) who found that feed conversion improved with feeding Pekin ducks on a high-energy diet (2900 & 3000 kcal ME/kg for starter and grower periods, respectively) compared to a low-energy one (2600 & 2700 kcal ME/kg for starter and grower periods, respectively). Furthermore, Leeson *et al.* (1996b) and Mahmoud and Szilagyi (1998) reported that as dietary energy level of broilers decreased, feed intake increased and was utilized less efficiently. Also, in accordance with the present results, it was found that feed intake and feed to gain ratio were not significantly affected by yeast culture supplementation of broiler diets (Kahraman *et al.*, 1997; Subrata *et al.*, 1997 and Abdel-Azeem, 2002). Moreover, Abdel-Azeem *et al.* (2001) and Abdel-Azeem (2002) found that efficiency of energy utilization was improved with feeding quails and broilers on yeast-supplemented diets.

Table (3): Effect of energy dilution with or without yeast culture on feed intake and feed conversion of Muscovy ducklings

Item	Adequate energy		Diluted energy	
	Without YC (control)	With YC	Without YC	With YC
Age intervals in weeks	Feed intake, g/duckling			
0-2	$476^{b}\pm8.1$	$462^{b}\pm21.4$	$509^{ab}\pm16.8$	$537^{a}\pm16.8$
2-4	$1531^{b}\pm16.8$	$1601^{ab}\pm30.6$	$1615^{a}\pm23.3$	$1596^{ab}\pm16.2$
4-6	$1722^{b}\pm29.1$	$1722^{b}\pm50.5$	$2231^{a}\pm53.8$	$2156^{a}\pm14.0$
6-8	$2455^{a}\pm24.7$	$2366^{b}\pm8.1$	$2506^{a}\pm28.0$	$2450^{a}\pm16.17$
8-10	$2338^{b}\pm21.4$	$2310^{b}\pm8.1$	$2680^{a}\pm28.0$	$2693^{a}\pm12.4$
10-12	$2231^{b}\pm12.4$	$2310^{c}\pm28.0$	$2268^{bc}\pm21.4$	$2478^{a}\pm16.2$
0-12	$10752^{b}\pm128$	$10780^{b}\pm112$	$11808^{a}\pm140$	$11956^{a}\pm74$
Age intervals in weeks	Energy Intake, kcal/duckling			
0-2	1400 ± 24	1362 ± 63	1392 ± 45	1402 ± 44
2-4	$4658^{c}\pm51$	$4874^{a}\pm93$	$4011^{b}\pm58$	$3968^{b}\pm40$
4-6	5240 ± 89	5243 ± 154	5541 ± 134	5360 ± 35
6-8	$7470^{a}\pm75$	$7204^{c}\pm25$	$6225^{b}\pm69$	$6091^{b}\pm40$
8-10	$7115^{a}\pm65$	$7034^{a}\pm25$	$6657^{b}\pm69$	$6694^{b}\pm31$
10-12	$6788^{b}\pm38$	$7034^{a}\pm85$	$5633^{c}\pm53$	$6160^{d}\pm40$
0-12	$32670^{a}\pm291$	$32751^{a}\pm393$	$29460^{b}\pm426$	$29674^{b}\pm207$
Age intervals in weeks	Feed conversion (feed/gain)			
0-2	$1.60^{a}\pm0.07$	$1.34^{b}\pm0.09$	$1.63^{a}\pm0.05$	$1.73^{a}\pm0.10$
2-4	1.80 ± 0.06	1.91 ± 0.10	2.06 ± 0.13	2.00 ± 0.14
4-6	$2.38^{b}\pm0.06$	$2.64^{b}\pm0.14$	$3.58^{a}\pm0.01$	$3.29^{a}\pm0.22$
6-8	3.40 ± 0.26	3.41 ± 0.24	4.40 ± 0.62	4.09 ± 0.17
8-10	5.68 ± 0.74	4.79 ± 0.17	6.57 ± 0.71	6.96 ± 1.21
10-12	5.55 ± 0.66	4.49 ± 0.36	5.76 ± 1.29	6.64 ± 1.14
Overall mean	3.12 ± 0.08	3.05 ± 0.12	3.78 ± 0.32	3.81 ± 0.34
Age intervals in weeks	Energy conversion (kcal/gain)			
0-2	$4.70^{a}\pm0.19$	$3.94^{b}\pm0.28$	$4.47^{ab}\pm0.13$	$4.52^{ab}\pm0.26$
2-4	5.48 ± 0.19	5.83 ± 0.32	5.12 ± 0.33	4.97 ± 0.35
4-6	$7.24^{b}\pm0.18$	$8.05^{ab}\pm0.43$	$8.91^{a}\pm0.03$	$8.19^{ab}\pm0.54$
6-8	10.34 ± 0.79	10.39 ± 0.74	10.92 ± 1.54	10.18 ± 0.41
8-10	17.28 ± 2.25	14.59 ± 0.53	16.32 ± 1.75	17.32 ± 3.1
10-12	16.87 ± 2.00	13.67 ± 1.10	14.30 ± 3.21	16.51 ± 2.83
Overall mean	9.49 ± 0.28	9.28 ± 0.45	9.43 ± 0.77	9.46 ± 0.82

Means in the same row without superscripts are not significantly different ($p>0.05$), while those having different superscripts differ significantly ($p\leq 0.05$).

Carcass characteristics

Results of carcass characteristics of experimental ducklings are shown in Table 4. Each of inedible parts, giblets and visceral and pad fats was decreased either as absolute weights or percentage values with feeding the diluted-energy diet, compared to the control. Such decrease in % visceral and pad fats was significant ($P\leq 0.05$). Moreover, edible parts and eviscerated carcass were also decreased as absolute weights but were not affected as % values, due to such decrease in dietary energy. Further decreases in giblets, edible parts, eviscerated carcass and visceral and pad fats did occurred either as absolute weights or as % values due to addition of YC to the diluted-energy diet compared to the control, but inedible parts was slightly increased due to such addition of YC. Addition of YC to the adequate-energy diet caused insignificant increases in inedible and edible parts and eviscerated carcass either as absolute or % weights, but it decreased giblets and visceral and pad fats. Because the diluted-energy diet differed only in energy content, so with the elevated feed intake of this diet, there was an increase in crude protein intake and this situation is known to reduce carcass fat deposition (Jackson *et al.*, 1982). Another reason for the decrease in carcass fatness of ducklings fed the diluted-energy diet is the decrease in energy intake itself despite of the elevated feed intake (Table 3). Kassim and Suwanpradit (1996) found that dressing percentage of broilers was not affected by increasing ME of the diet but increases in abdominal and carcass fats occurred with such high-energy diets. In addition, Mahmoud and Szilagyi (1998) found that the low-energy level in the grower-finisher diets of broilers resulted in concomitant decreases in weights of eviscerated carcass, liver, breast yield, total edible parts and abdominal fat contents. Also, in agreement with the present results, Kahraman *et al.*, (1997) and Abdel-Azeem (2002) observed no significant differences in dressing percentage of broilers due to yeast culture supplementation of the diets. Furthermore, Onifade (1997) and Onifade *et al.* (1999) found that feeding broilers on yeast supplemented diets improved carcass yield and reduced abdominal fat.

Table (4): Effect of energy dilution with or without yeast culture on carcass characteristics of Muscovy ducklings

Item		Adequate energy		Diluted energy	
		Without YC (control)	With YC	Without YC	With YC
Live body weight,	g	3483	3440	3217	3000
Inedible parts,	g	493	514	450	470
	%	14.15±1.34	14.94±0.28	13.99±0.99	15.67±0.56
Giblets,	g	243	208	203	127
	%	6.98^{a}±0.51	6.05^{ab}±0.29	6.31^{a}±1.13	4.23^{b}±0.13
Edible parts,	g	2815	2856	2616	2322
	%	80.82±1.37	83.02±0.14	81.32±1.08	77.40±0.94
Eviscerated carcass,	g	2233	2314	2095	1957
	%	64.11±1.80	67.27±0.77	65.12±2.20	65.23±1.50
Visceral fat,	g	72	59	35	27
	%	2.07^{a}±0.42	1.72^{a}±0.41	1.09^{b}±0.45	0.90^{b}±0.45
Pad fat,	g	50	39	29	16
	%	1.44^{a}±0.16	1.13^{a}±0.30	0.90^{b}±0.34	0.53^{b}±.013

Means in the same row without superscripts are not significantly different ($p > 0.05$), while those having different superscripts differ significantly ($p \leq 0.05$).

Meat analysis

Results of meat analysis of ducklings' meat are shown in Table 5. Decreasing dietary energy had no significant effect on meat crude protein or ash, while resulted in a significant increase in moisture content of meat with a significant decrease in its ether extract (20.6%) compared to the control. Addition of YC to the diluted-energy diet resulted in significant decrease in meat ash with 15.3% decrease in its ether extract compared to the diluted-energy diet (such decrease was 32.8% compared to the control). Moreover, addition of YC to the adequate-energy diet did not affect moisture or ash contents of meat but significantly decreased its ether extract (by 30.7%).

Kassim and Suwanpradit (1996) found that increased dietary ME increased carcass fat with a significant reduction in protein content. They added that an increase in fat content always resulted in a reduction in protein content of the meat.

Table 5. Effect of energy dilution with or without yeast culture on nutrient composition of ducklings' meat (on fresh basis).

Nutrient, %	Adequate energy		Diluted energy	
	Without YC (control)	With YC	Without YC	With YC
Moisture	73.23[b]±0.17	74.26[ab]±0.17	74.61[a]±0.62	74.94[a]±0.25
Crude protein	24.45±0.12	23.95±0.43	24.11±0.87	23.84±0.37
Ether extract	1.89[a]±0.02	1.31[b] ±0.01	1.50[b] ±0.19	1.27[b]±0.06
Ash	1.34[a]±0.01	1.31[a]±0.05	1.31[a]±0.003	1.21[b]±0.01

Means in the same row without superscripts are not significantly different (p> 0.05), while those having different superscripts differ significantly (p≤ 0.05).

Economic efficiency

Results of economic efficiency of feeding Muscovy ducklings on the experimental diets are presented in Table 6. Total and net revenue from ducklings fed on the diluted-energy diet either with or without YC addition were decreased due to the increase in feed cost with the associated decrease in body weight, which resulted in lower economic efficiency relative to the control. On the other hand, feed cost of the adequate-energy diet plus added YC increased relative to the control but the increase in body weight of this group compensated such cost as to be of similar economic efficiency.

Table 6. Economic evaluation of energy dilution with or without yeast culture of diets fed to Muscovy ducklings

Item	Adequate energy		Diluted energy	
	Without YC (control)	With YC	Without YC	With YC
Starter feed intake, kg	0.476	0.462	0.509	0.537
Grower feed intake, kg	10.276	10.318	11.299	11.419
Price of kg starter feed, LE	0.81	0.85	0.80	0.85
Price of kg grower feed, LE	0.77	0.79	0.73	0.75
Feed cost of starter diet, LE	0.39	0.39	0.41	0.46
Feed cost of grower diet, LE	7.91	8.15	8.25	8.56
Total feed cost /duckling, LE	8.30	8.54	8.66	9.02
Total cost/duckling, LE [1]	13.30	13.54	13.66	14.02
Final live weight /duckling, kg	3.500	3.592	3.228	3.242
Total revenue/duckling, LE [2]	31.50	32.33	29.05	29.18
Net revenue/duckling, LE [3]	18.20	18.79	15.39	15.16
Economic efficiency [4]	1.37	1.39	1.13	1.08
Relative economic efficiency [5]	100	101.46	82.48	78.83

[1] Feed cost + price of purchasing of one-day old duckling (5 L E)
[2] Selling price of duckling, was 9 LE/kg live weight.
[3] Selling price of duckling- total cost
[4] Net revenue per unit of total cost.
[5] Assuming that relative economic efficiency of the control treatment = 100

CONCLUSION

It is concluded that diluting dietary energy of Muscovy ducklings achieved desired reduction in carcass fatness, but it decreased carcass yield and negatively affected economic efficiency. Addition of YC to such diluted-energy diet caused further decrease in carcass fatness with small increase in carcass yield without improving economic efficiency. Addition of YC to adequate-energy diet caused a slight increase in carcass yield with a relatively smaller decrease in carcass fatness compared to energy dilution, without affecting economic efficiency.

However, the lower economic efficiency of the diluted-energy diet with or without added YC is also due to the constant selling price of unit live weight regardless of the importance of the healthy lower fattened carcasses of such ducklings. If such advantage is taken in consideration in future, the economic efficiency may improve.

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أداء البط المسكوفى المغذى على عليقة ذات محتوى مخفف من الطاقة ومزرعة الخميرة

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استخدم فى هذه التجربة عدد ١٢٠ كتكوت بط مسكوفى غير مجنس عمر يوم حيث تم تقسيمها إلى ٤ مجاميع متساوية بكل منها ٣ مكررات(١٠ كتاكيت لكل مكرر). غذيت هذه الطيور على علائق بادئة لمدة ١٤ يوما الأولى بعد الفقس تلاها علائق نامية حتى نهاية التجربة (١٢ أسبوع). اختلفت هذه العلائق فى محتواها من الطاقة وكذلك من حيث احتوائها على أحد مزارع الخميرة لتكون ٤ معاملات غذائية هى: العليقة الأولى (المقارنة) احتوت على مستوى كافى من الطاقة (٢٩٤٠، ٣٠٤٠ كيلو كالورى طاقة ممثلة /كجم خلال مرحلة البادئ والنامى على التوالى). العليقة الثانية كانت مثل العليقة الأولى ولكن مع إضافة مزرعة الخميرة. العليقة الثالثة احتوت على مستوى منخفض من الطاقة (٢٧٠٠ ، ٢٤٨٠ كيلو كالورى طاقة ممثلة /كجم خلال مرحلة البادئ والنامى على التوالى). العليقة الرابعة كانت مثل العليقة الثالثة ولكن مع إضافة مزرعة الخميرة.

أوضحت النتائج انخفاض وزن الجسم والزيادة المكتسبة فى الوزن بخفض مستوى الطاقة بالعليقة خلال معظم فترات العمر مع حدوث زيادات غير معنوية مع إضافة مزرعة الخميرة ولكن ظل وزن الجسم النهائى منخفضا مقارنة بمجموعة المقارنة.أدى إضافة مزرعة الخميرة إلى العليقة ذات المحتوى الكافى من الطاقة إلى تحسن النمو خلال العمر المبكر ولكن لم يكن له تأثير بعد ذلك. ازداد المأكول من العليقة بانخفاض مستوى الطاقة مع حدوث زيادة أخرى عند إضافة مزرعة الخميرة ولكن هذه الزيادات لم تستطع المحافظة على مستوى المأكول من الطاقة مشابها لمجموعة المقارنة. لم يؤثر إضافة مزرعة الخميرة إلى العليقة ذات المحتوى الكافى من الطاقة على المأكول اليومى. كان البط المغذى على عليقة منخفضة الطاقة سواء مع أو بدون إضافة مزرعة الخميرة أقل كفاءة فى تحويل الغذاء المأكول. إضافة مزرعة الخميرة إلى العليقة ذات المحتوى الكافي من الطاقة حسن الكفاءة التحويلية للغذاء خلال العمر المبكر ولكنه لم يؤثر بعد ذلك. ولكن على الرغم من ذلك فإن خفض محتوى العليقة من الطاقة سواء مع أو بدون إضافة مزرعة الخميرة وأيضا إضافة مزرعة الخميرة إلى العليقة ذات المحتوى الكافي من الطاقة أدى لتحسن الكفاءة التحويلية لطاقة الغذاء إلى زيادة وزنية.

أوضحت النتائج أيضا انخفاض وزن الأجزاء الماكولة وغير الماكولة ووزن الذبيحة ودهن الأحشاء ودهن البطن نتيجة خفض مستوى طاقة الغذاء مع حدوث انخفاض أخر نتيجة إضافة مزرعة الخميرة. أدى إضافة مزرعة الخميرة إلى العليقة ذات المحتوى الكافي من الطاقة إلى حدوث زيادة غير معنوية فى وزن الذبيحة مع انخفاض قليل فى دهن الأحشاء ودهن البطن. لم يؤثر خفض مستوى طاقة العليقة على محتوى اللحم من البروتين ولكنه خفض محتواه من الدهن. أدى إضافة مزرعة الخميرة إلى العليقة ذات المحتوى الكافي من الطاقة لانخفاض معنوى فى محتوى اللحم من الدهن.

من هذه النتائج يمكن استخلاص أن تغذية كتاكيت البط المسكوفى على علائق منخفضة الطاقة قد أدى إلى انخفاض مرغوب فى محتوى الذبيحة من الدهن ولكنه أدى لخفض وزن الذبيحة مع التأثير السلبى على الكفاءة الاقتصادية. بينما أدى إضافة مزرعة الخميرة لهذه العليقة المنخفضة الطاقة لمزيد من الانخفاض فى دهن الذبيحة مع زيادة قليلة فى وزن الذبيحة دون تحسين الكفاءة الاقتصادية. وقد أدى إضافة مزرعة الخميرة إلى العليقة ذات المحتوى الكافي من الطاقة إلى زيادة طفيفة فى وزن الذبيحة مع انخفاض قليل فى دهن الذبيحة بدون التأثير على الكفاءة الاقتصادية.