EFFECTIVENESS OF MOLASSES YEASTS IN BROILER DIETS

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Abstract

The objective of the present study was to determine the effectiveness of yeasts in broiler diets, on the basis of growing performance, nutrient digestibility and carcass dressing percentage. Dried, inactive molasses yeasts (*Saccharomyces*) were used in the experiment.

This study was performed on 144 one-day-old Ross 208 cockerel chicks divided into 3 groups, 48 chicks each (six replications, eight birds each, within each group). The cockerels were kept in three-tier cages. They were reared in controlled environmental conditions until the age of 39 days.

The diet given to group C (control) was not supplemented with dried yeasts. It contained animal protein (5%) in the form of meat meal. Dried yeasts in the amount of 3% (starter diet) and 5% (grower diet), and 5% and 7.8% were added to diets for groups E-1 and E-2, respectively. Yeast supplementation of the diets allowed to reduce soybean meal content by 2.5 to 4%, and to replace completely meat meal in the grower diet for group E-2.

The results indicated that, diets for broiler chicks can be supplemented with molasses yeasts. Yeasts added in the amount of 7.8% to diets for Ross 208 cockerel chicks reduced the digestibility of N-free extracts, but had no effect on body weight gains, feed consumption and survival rate or carcass dressing percentage. Adding yeasts to diets for broiler chicks increased feed cost per kg BW gain by 8 to l4%.

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INTRODUCTION

In order to control the spread of bovine spongiform encephalopathy (BSE), a ban on the use of mammalian meals in animal feeding was introduced in Europe, thus, limiting considerably the supply of high-protein raw materials, which had to be replaced with feed components of plant origin. Dried yeasts, in the form of live or attenuated cultures, may be applied to reduce feed protein deficiency, regulate digestion processes and prevent alimentary diseases in animals (Besnard *et al.*, 2000). For over a hundred years, yeasts have been known as a valuable source of vitamin B complex and some bioelements, but first of all digestible protein (Dobrzański and Opaliński, 2002 and Gajewczyk, 1984). The concentration of available lysine is more differentiated (48 to 76%), in some yeast strains even low (Buraczewski *et al.*, 1972). The biological value of yeast protein (approx. 60%), compared with egg white (100%), is limited by sulfuric amino acids. However, when supplemented with methionine, the value of yeast protein increases to 90% and is comparable with animal protein (Buraczewski *et al.*, 1972).

In Poland fodder yeast production is based on traditional raw materials, mostly waste products of the sugar, distilling and pulp-and-paper industry. These yeasts are post-fermentation by-products from breweries or distilleries, and strains grown on various media, including industrial wastes (Fritz *et al.*, 1991, Konieczna, 1993). Small amounts of whey and lactose-fermenting yeasts are also produced (Buraczewski *et al.*, 1972).

The most popular feed components are dried brewer's yeasts (*Saccharomyces*) and fodder yeasts (*Torula*) (Scott *et al.*, 1978). Verma and Singh (1990) found that inactivated dried yeasts obtained during molasses fermentation with *Saccharomyces cerevisiae* may be used for the production of economical, balanced feed mixtures for poultry. According to Buraczewski *et al.* (1972), the nutritive value of feed yeasts differs significantly depending on their strain, method of yeast milk drying and type of medium used for their proliferation.

Amino acids constitute only 73-75% of yeast protein, the rest are nucleic acids (10-14%), free nucleotides and other nitrogen compounds not possessing amino acid structure. Their too high amounts have a negative effect on the energy balance of monogastric animals (Buraczewski *et al.*, 1972 and Gajewczyk, 1984). That is why according to the Nutrient Requirements of Poultry, the maximum content of yeasts in diets for chickens should be 5 to 8%, depending on their age and direction of breeding.

In the experiment performed by Fritz *et al.* (1991), chickens were fed diets containing 5% brewer's and molasses yeasts or yeasts grown on fuller's (bleaching) earth. The production results were similar to those obtained in the case of standard diets containing no yeasts. Diet supplementation with 10% yeasts grown on fuller's earth caused a decrease in body weight gains and feed conversion.

The objective of the present study was to determine the effectiveness of molasses yeasts in broiler chicken nutrition, on the basis of rearing results, nutrient digestibility and carcass dressing percentage.

MATERIALS AND METHODS

The experiment was performed on an experimental farm owned by the Department of Poultry Breeding, University of Warmia and Mazury in Olsztyn, Poland.

The experimental material comprised 144 one-day-old Ross 208 cockerel chicks, randomly allocated to three feeding groups, 48 chicks each (six replications, eight birds each within each group). They were reared under controlled conditions, in accordance with relevant standards. The cockerels were kept in three-tier cages, providing artificial light only (no daylight)-continuous to three days of age and from 36 to 39 days, and cyclical (two cycles, 6 h light, 6 h dark) from 4 to 35 days of age.

Dried, inactive molasses yeasts *Saccharomyces*, whose chemical composition (AOAC, 1985) is given in Table 1, were used in the experiment.

The chicks were fed *ad libitum* friable starter and grower diets (Table 2) and had free access to water. The components and chemical composition of diets are presented in Table 2. The diet given to group C (control) was not supplemented with yeasts. It contained animal protein (5%) in the form of meat meal (55% CP). Dried yeasts in the amount of 3% (starter) and 5% (grower), and 5% and 7.8% were added to diets for groups E-1 and E-2, respectively. The grower diet for group E-2 contained no meat meal. The diets were balanced to achieve the same levels of metabolizable energy, crude protein and other components.

The results of experimental feeding were evaluated based on body weights at 21 and 39 days of age, and feed consumption (per week, in each replication). Mortality and culling rates (+ cause) were also determined. These data provided the basis for calculating the European Production Index (EPI):

$$EPI = \frac{\text{mean body weight of chicks (kg) x mortality rate (\%)}}{\text{rearing period (days) x feed conversion ratio (kg feed/ kg BW)}} \times 100$$

In the fourth week of rearing, nutrient digestibility was determined by the simple balance method. Four broilers selected randomly from each group were put into individual metabolic cages. After a three-day preliminary period, the amounts of feed consumed and feces and urine were recorded on six consecutive days. The nutrient content of yeasts, diets, feces and~urine was determined by the Weenden method. Gross energy concentration was determined in a KL-10 adiabatic calorimetric bomb. Feces nitrogen and urine nitrogen were separated by the method proposed by Ekman *et al.* (1949) in feces/urine samples dried at a temperature of 50^{0}C. The results were used for calculating nutrient apparent digestibility in grower diets.

At 39 days of rearing, six broilers of each group whose body weights were similar to the average in a given group were fasted for 12 hours, and then, slaughtered. Carcasses were chilled at 4^{0}C for 24 hours, weighed and partly dissected. The weights of eviscerated carcasses, abdominal fat, breast, thigh and drumstick muscles were determined.

The results were analyzed statistically by analysis of variance. The significance of differences between means was evaluated by the Duncan's test according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

The chemical composition of yeasts is presented in Table 1. Crude protein content and crude fat content amounted to approx. 42% and 0.3% respectively, and were lower than declared on the label (43.5% and 0.65%). The levels of N-free extracts and crude ash (42% and 14%, respectively) were similar to those declared by the manufacturer. The chemical composition and regression equations, derived using the energy value of feed for poultry listed in the European Table of Energy for Poultry Feedstuffs (1989), provided the basis for calculating the metabolizable energy content of yeasts (9.7 to 9.9 MJ/kg DM). Reference data show that the chemical composition of molasses yeasts can vary greatly, depending mostly on the method of drying. According to various authors, crude protein concentration in yeasts is 43 to 47%, crude fat 1.3 to 4.0%, crude ash 7.3 to 8.9%, N-free extracts 36 to 42%, and metabolizable energy 12 to 15 MJ/kg DM (Dobrzański and Opaliński, 2002, Gajewczyk, 1984, and Verma and Singh, 1990). Yeast supplementation of feed mixtures allowed to reduce soybean meal content by 2.5 to 4%, and to replace completely meat meal in the grower diet for group E-2. Yeasts had no effect on the nutritive value of diets, which fully met the nutrient poultry requirements according to NRC (1984).

Growth performance

Mean daily gains and body weights of broilers are given in Table 3. At the first stage of rearing (to 21 days of age), all chicks were characterized by uniform daily gains, about 26 g/bird/day. Statistically, significant differences were recorded at the second stage of rearing (22 to 39 days of age), when broilers were fed the experimental grower diets. The lowest body weight gains were observed in group E-1 (62.6 g/bird/day), compared with the control group (65.7 g/bird/day), the difference was 4.7% ($P \leq 0.05$). However, no significant differences were found in body weight gains over the entire experimental period (39 days). There was no correlation between body weight gains and yeast content of diets. Broilers fed a diet with a higher and lower concentration of yeasts (groups E-2 and E- 1 respectively) showed a similar growth rate.

Body weights of broiler chickens (Table 3) aged 21 days varied from 582 g to 604 g. Better results (by 1.5 to 3.8%) were achieved for broilers fed diets containing yeasts (groups E-1 and E-2), but, these differences were not statistically significant. At the end of the rearing period, the body weights of cockerels aged 39 days varied from 1727 to 1765 g. Broilers fed diets containing yeasts were slightly lighter (by 1.5 to 2.2%), but, these differences were not confirmed statistically, similarly as at 21 days of age. Also, Fritz *et al.* (1991) reported similar production results in broiler chickens fed standard diets and diets containing up to 5% yeasts. The 10% yeast diet caused a reduction in both body weight gains and feed conversion by 7% and 4%, respectively. Mean body weights of Ross 208 broiler chicks aged 21 days were comparable with those recorded by other authors (Faruga *et al.*, 2001, Mikulski *et al.*, 1999), but, at the end of the experimental period (39 days), they were below their potential possibilities, even by about 500 g (Ross broiler performance objectives 2002).

Feed intake (Table 4) per kg BW gain (FCR) was at a similar level in the broilers fed diets supplemented with yeasts (groups E-1 and E-2), and in the control group (C), i.e. approx. 1.44 kg feed to 21 days of age and 1.84-1.85 kg feed between 22 and 39 days of age. Feed conversion ratio was approx. 1.71 kg/kg for the entire experimental period (1-39 days).

Distinct differences were observed in the economic indices analyzed in the study. Table 4 presents feed cost per kg BW gain during the rearing period (39 days). Assuming the cost of feed consumed to get 1 kg gain in the control group (C) as 100%, it was found that feeding diets containing yeasts to broilers increased the overall feed cost by approx. 8% (group E-1) to 14% (group E-2). Feed conversion ratio of 1.71 kg/kg, recorded in this study, is close to the optimum level, achieved for properly balanced rations, corresponding with the nutrient requirements of growing broiler chickens (Ross broiler performance objectives 2002, Faruga *et al.* 2001).

During the first days of rearing, several chicks died of yolk sac inflammation. These cases were considered natural losses, not associated with the experimental factor. Mortality rate was 4.2% in the control group (two broilers), and 2.1% in the experimental groups (one broiler in each), which indicates a good survival rate, especially that a similar mortality rate was reported by Faruga *et al.* (1998, 2001) and Gawęcki (200l).

An evaluation of rearing results, expressed as efficiency factor (Table 4), shows that they were not affected by yeast content of experimental diets. The efficiency factor determined for the whole experimental period was at a similar level in all groups, i.e. 263 points in the control group, 259 points in group E-1 and 261 points in group E-2. Similar results of broiler rearing were also obtained by other authors (Faruga *et al.*, 1998, Gawęcki, 2001).

Nutrient digestibility and nitrogen retention

Nutrient digestibility coefficients and nitrogen retention are presented in Table

5. In the cockerels of groups E- 1 and E-2, fed yeast-supplemented diets, crude fiber digestibility, improved by 2.3 and 9.4 percentage points, respectively ($P \leq 0.05$), but, the digestibility of N -free extractives decreased by 2 and 3.5 percentage points ($P \leq 0.01$). No statistically significant differences were noted in the digestibility of crude protein (85.0-87.2%), organic matter (75.7-77.6%), crude fat (76.1-78.1%), gross energy (75.5-77.4%), and nitrogen retention (56.9-58.5%). When the yeast content of the starter and grower diets increased to 5% and 7.8%, respectively (group E-2), crude fiber digestibility improved by approx. 60% ($P \leq 0.05$), but, the digestibility of N-free extract was reduced by 1.7% ($P \leq 0.05$).

The digestibility of protein and fiber, nitrogen retention and gross energy utilization achieved in this study were similar to or higher than those reported by Mikulski *et al.* (1999), and the digestibility values of fat and N-free extracts were higher than those obtained by Faruga *et al.* (1998). As demonstrated by Fritz *et al.* (1991), a 5% yeast content of feed for broiler chicks had no effect on nutrient digestibility, but, adding 10% yeasts to diets resulted in reduced digestibility of fat and fiber.

Slaughter analysis

The results of a slaughter analysis of broilers (Table 6) did not indicate any significant differences in particular parameters. The carcass dressing percentage of Ross 208 cockerel chicks was 70.2 to 71.0%, including breast muscles -14.9 to 16.1%, leg muscles -15.6 to 16.3%, total muscles -30.5 to 32.1%, and internal fat content - 1.0 to 1.35%. The results of carcass dressing percentage were close to the optimum for Ross 208 hybrids with body weights below 2 kg (Ross broiler performance objectives 2002), and comparable with those reported by Faruga *et al.* (1998).

CONCLUSION

1. The results of the present study indicated that diets for Ross 208 cockerel chicks can be supplemented with molasses yeasts.
2. Yeasts added in the amount of 7.8% to diets for broiler chicks reduced the digestibility of N-free extractives, but, had no effect on body weight gains, feed consumption or survival rate.
3. Carcass dressing percentage was not affected by yeast supplementation of diets.
4. Adding yeasts to diets for broiler chicks increased feed cost per kg BW gain by 8 to 14%. This confirms the opinions that, if yeasts are to be widely used as components of diets for poultry, the costs of their production must be reduced.

Table 1. Chemical composition of fodder yeast.

Specification	Manufacturers analyses	Chemical analyses
Dry matter	91.1	95.9
Crude protein	43.5	41.9
Crude fat	0.65	0.32
Crude fiber	-	1.48
Crude ash	14.0	14.0
N-free extractives	41.9	42.3
Metabolizanble energy, Mj/kg	9.9*	9.7*

* Calculated according to European Table of Energy. Values for Poultry Feedstuffs (1989): AMEn (kJ/kg DM)=13.71 x digestibility protein + 22.13 x digestibility fat + 14.72 x digestibility N-free extractives.

Table 2. Percent composition of the experimental diets.

Ingredients	Feeding groups					
	C		E-1		E-2	
	Starter	Grower	Starter	Grower	Starter	Grower
Wheat (12%CP)	52.09	55.43	51.32	55.08	50.45	49.29
Corn (9%CP)	15.00	15.00	15.00	15.00	15.00	15.00
Extracted soybean meal (46%CP)	23.14	19.28	20.87	15.08	19.80	20.42
Meat meal (55%CP)	5.00	5.00	5.00	5.00	5.00	-
Molasses yeast	-	-	3.00	5.00	5.00	7.80
Rapeseed oil	1.59	2.71	1.58	2.38	1.55	3.76
Fodder salt (NaCl)	0.18	0.19	0.18	0.18	0.18	0.19
Limestone	0.44	0.14	0.73	0.36	0.83	1.14
Dicalcuim phosphate	1.10	0.56	0.63	0.19	0.50	0.68
Na_3PO_4	-	0.24	0.20	0.24	0.20	0.24
Digest Acid acidifier	0.10	0.10	0.10	0.10	0.10	0.10
DL-Methionine 99%	0.22	0.13	0.23	0.14	0.24	0.15
Lysine HCl 99%	0.14	0.22	0.16	0.25	0.15	0.23
Mineral-vitamin premix(1)	1.00	1.00	1.00	1.00	1.00	1.00
Nutritional value of feed diets						
Crude protein (N x 6.25)	21.30	20.31	21.30	20.32	21.50	20.72
Crude fiber	2.94	2.45	2.84	2.46	2.79	2.51
TMEn MJ/kg	12.34	12.76	12.34	12.76	12.35	12.76
Lysine	1.18	1.14	1.18	1.14	1.18	1.14
Methionine	0.54	0.53	0.54	0.53	0.55	0.53
Calcium	0.95	0.95	0.95	0.95	0.96	0.96
Available phosphorus	0.45	0.42	0.45	0.42	0.45	0.42

Vit A 10,000,000 IU, Vit D_3 100,000; Vit E 10,000 mg, Vit K_3 1,000 mg, Vit B_1 1,000 mg, Vit B_2 4,000 mg, Vit B_6 1,500 mg, Vit B_{12} 10 mg; Nycim 20,000 mg; Panthonic acid 10,000 mg, Folic acid 1,000 mg, Selenium 100 mg, Coline chloride 500, 000 mg, Cu 3,000 mg, Iodine 300 mg, Fe 30,000 mg; Mn 40,000 mg, Zn 45,000 mg.

Table 3. Daily body weight gain (g/bird) and mean body weight (g) of broiler chicks.

Period, days	Statistical parameters	Feeding groups		
		C	E-1	E-2
Daily body weight gain:				
1-21	Mean ± SD	25.7±1.55a	26.3±1.60a	26.0±0.61a
22-39	Mean ± SD	65.7±1.20a	62.6±2.7b	63.9±1.8ab
1-39	Mean ± SD	44.2±0.70a	43.1±2.6a	43.4±1.8a
Body weight:				
21	Mean ± SD	582.0±75.6a	604.0±56.0a	591.0±61.0a
39	Mean ± SD	1765.0±134.0a	1727.0±105.0a	1739.0±139.0a

values with different letters differ significantly : a, b P≤0.05

Table 4. Mean periodic feed conversion ratio (g feed/kg LBW), production index and costs of feed intake.

Parameter	Statistical parameters	Feeding groups		
		C	E-1	E-2
FCR				
1-21 days	Mean ± SD	1441±0.04a	1436±0.04a	1437±0.02a
22-39 days	Mean ± SD	1836±0.01a	1853±0.01a	1846±0.02a
1-39 days	Mean ± SD	1709±0.02a	1709±0.01a	1707±0.01a
European Production Index (EPI)				
(1-39 days)	Point	263a	259a	261a
Cost of feed				
(1-39 days)	Zl[1]	1.44	1.56	1.65
	LE[2]	3.19	3.45	3.65

1 Zloty = 0.369 Dollar 2 Egyptian pound = 0.167 Dollar
values with different letters differ significantly : a, b P≤0.05

Table 5. Digestibility coefficients of nutrients and nitrogen retention %.

Parameter	Statistical parameters	Feeding groups		
		C	E-1	E-2
Organic matter	Mean ± SD	77.64±0.59	76.67±0.80	75.66±1.37
Crude protein	Mean ± SD	85.04±0.45	86.13±0.56	87.19±0.35
Crude fat	Mean ± SD	76.92±0.20	76.06±0.41	78.11±0.81
Crude fiber	Mean ± SD	9.31±2.40a	11.63±3.02a	18.77±4.57b
N-free extractive	Mean ± SD	88.33±0.31A	86.30±0.47Ba	84.84±0.85Bb
Gross energy	Mean ± SD	77.43±0.60	76.97±0.79	75.55±1.38
Retention N intake	Mean ± SD	56.87±1.14	58.46±1.42	57.91±2.37

Means followed by different letters are statistically significantly different at : a, b $P \leq 0.05$; A,B $P \leq 0.01$

Table 6. Digestibility coefficients of nutrients and nitrogen retention %.

Parameter	Statistical parameters	Feeding groups		
		C	E-1	E-2
Dressing percentage	Mean ± SD	71.02±0.52	70.20±0.69	70.50±0.68
Edible giblets	Mean ± SD	4.02±0.08	4.19±0.30	4.15±0.19
Breast muscles	Mean ± SD	15.84±0.52	14.90±0.19	16.13±1.08
Thigh muscles	Mean ± SD	9.54±0.79	9.19±0.14	9.44±0.33
Drumstick muscles	Mean ± SD	6.76±0.19	6.36±0.29	6.25±0.43
Abdominal fat	Mean ± SD	0.70±0.04	1.09±0.40	0.79±0.26

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كفاءة خميرة المولاس فى تغذيه كتاكيت التسمين

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كان الهدف من تلك الدراسه تقدير كفاءة التغذيه بخميرة المولاس على كتاكيت التسمين وكـذلك تقدير معامل الهضم ونسبه التصافى.

اجريت هذة الدراسه على ١٤٤ ديك عمر يوم من كتاكيت Ross 208، قسمت الى ٣ مجموعات بكل منها ٤٨ كتكوت (٦مكررات بكل منها ٨ طيور داخل كل مجموعه). ربيت الطيور فى اقفـاص تحت ظروف بيئيه متحكم بها حتى عمر ٣٩ يوماً. واستخدمت فى هذه الدراسه خميـرة المـولاس الغير نشطه *Saccharomyces* .

غذيت المجموعه ج (الكنترول) على عليقه لا تحتوى على الخميرة. وكانت تحتوى على ٥,٠% بروتين حيوانى فى غذائها فى صورة مسحوق لحم وأضيفت الخميرة الجافـه بمعـدل ٣,٠% (عليقه البادئ) و بنسبه ٥,٠ % (عليقه النامى) وبنسبه ٥% و٧,٨% لكليتا المجموعتين E-1 و E-2 على الترتيب. وقد ادت اضافه الخميرة إلى العلائق إلى خفض نسبه كسب فول الصويا بهـا بنسبه ٢,٥ و ٤,٠% واستبدلت كليا مسحوق اللحم فى العلف النامى للمجموعه E-2.

أوضحت النتائج أن عليقه كتاكيت التسمين يمكن أن يضاف إليها خميرة المولاس الجافه. وأن إضافه الخميرة بمعدل ٧,٨% إلى علف ذكور كتاكيت التسمين Ross 208 خفضت من النيتـروجين الحر المفرز مع الزرق ولكن لم يكن لها تاثير على معدل الزيادة فى وزن الجسم والعلف المسـتهلك ومعدل النفوق أو نسبه التصافى. وتبين أن اضافه الخميرة إلى عليقه كتاكيت التسمين يزيد من تكلفه العلف لكل كجم من وزن الجسم المكتسب بنسبه ٨,٠ إلى ١٤,٠%