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Studies on Factors to Increase Mold Inhibitor Effectiveness in Livestock Rations[1)]

II. Effects of the Usage of a Mold Inhibitor in the Ration on the Nutritional Status and Performance of Chicks

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배합사료에 대한 항곰팡이제의 효과적인 처리 방법과 사료내 영양소 보전 방법

II. 항곰팡이제의 이용이 사료 영양소 보전 및 병아리 성장에 미치는 요인.

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적　요

단백질 수준이 18%인 초생추 사료와 12%인 비육우 후반기 사료를 입자도의 크기에 따라 전 사료의 80%가 1.19mm 이하인것과 전 사료의 40%가 1.19mm 이하인 것으로 나누어서 40일간 저장후 각 처리구의 영양소 변화를 비교 하였다.

영양소 변화를 비교한후 초생추 사료만을 이용하여 입자의 크기를 다르게 하여 항곰팡이제를 처리한 사료와 처리하지 않은 사료에 대한 병아리의 성장 및 사료이용 정도 그리고 장기의 발달을 비교 하였다.

항곰팡이가 처리되지 않은 사료에서는 2개의 다른 단백질 수준에서 공히 지방과 카로틴 함량은 현저히($P<0.05$) 감소를 초래하였다. 항곰팡이제가 처리된 사료에서도 입자 크기가 1.19mm 보다 작은 것이 전체 사료의 40% 이하인 구에서는 지방과 카로틴의 함량이 40일간의 저장후에는 감소하는 추세를 보였다.

또 입자가 큰 사료에서 항곰팡이제를 처리하지 않았을 때는 신선한 사료나 항곰팡이제를 처리한 구에 비교하여 병아리의 성장이나 사료 섭취량은 현저히 감소($P<0.05$)를 나타냈다. 사료효율 역시 항곰팡이제를 처리하지 않은 구에서 현저히 낮았다.($P<0.05$), 그러나 각 장기의 무게에는 처리간에 차이를 나타내지 못하였다.

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I. INTRODUCTION

Fungal growth in feed stuffs can cause severe losses to the livestock industry by decreasing the nutritional values of diets and producing mycotoxins. Fritz et al. (1973) and Sharby et al. (1973) reported that chicks fed diets containing corn infested by various fungi showed a depressed weight gain and feed efficiency.

The effects of various mycotoxins on chicks were studied extensively during the last decade (Carlton and Krogh, 1979 ; Pier, 1981 ; Bartov et al., 1982).

Richardson et al. (1962) observed in poults receiving moldy soybean meal a growth depression that was prevented by the addition of lysine. Fritz et al. (1973) noted that fusarium moniliforme caused thiamine deficiency. Bartov et al. (1982) also reported that fat content in moistned ground grains decreased markedly during storage, but fatty acid ratios, vitamin E, carotene, xanthophyll, and protein levels were not markedly affected.

Recently various types of mold inhibitors have been started to be used in feed storage, but the possible effect of fungi under the usage of mold inhibitor on the nutritional value of feedstuffs has not received much attention.

The objective of this work is to study whether fungal develpment after 40 days of storage of feedstuffs mixed with mold inhibitor adversely affects the nutritional value of a diet or the chick performance compared with that of an untreated feed.

II. MATERIALS AND METHODS

A) Experimental procedure for nutritional changes

The experiments were on the effect of particle size of two differnet level of protein(18% of chick starter and 12% for beef ration) on the inhibitor and the interactions between particle size and protein levels on the inhibitor. The experimental diets were passed through a 1mm mesh and seperated into two particle size ranges with using of a U.S Standard mesh screen : (1) 80% of the particles in the experimental ration less than 1.19mm, (2) 40% of the particle size in the experimenal ration less than 1.19mm.

A commercial fungistat was mixed in the treated diets at the level of 0.1% (W/W). The powder fungistat was obtained from the mold inhibitor company directly.

The experimental diets were divided into four plastic cans of 3kg for each treatment and the cans were closed (not hermitically) and placed in the incubator which was converted from and egg incubator with and evaporative, forced air humidifier at 85% and a controlled-temperature at 29+1℃. Relative humidity was measured with a wet-bulb thermometer. Similar cans were filled with the untreated experimental diets with mold inhibitor and were kept in an egg incubator in the same manner as the treated diet. The fresh diet served as a control. After 40 days of storage sampling was done from each can to investigate the nutritional change in each treatment.

Samples were transported to the laboratory in plastic bags and frozeen at −25℃ until analyzed.

A 2×3 factorial experiment was carried out. The experimental design was composed of 6 treatments and 4 replicates per treatment. The means were calculated by analysis of variance in which a F−ratio was calculated. If significant (P <0.05), the least significant difference among means was calculated (Barr et al., 1976).

B) Chemical methods for feed sample analyses

The amount of moisture, crude fat, carotene and crude protein in samples were determined using the AOAC methods (AOAC, 1980). ADF value was analyzed using the method of Goering and Van Soest(1970).

C) Chick performance

Day−old Hubbard male chicks were raised in electrically heated battery brooders. After a preparatory period of 7 days, during which time the chicks were fed a commercial starter diet, the chicks were wing−banded and divided into 6 treat-ments with 4 replicates per treatment and 10 birds per replicate.

A 2×3 factorial experiment was carried out. The means were calculated by analyses of variance in which an F-ratio was calculated. If significant (P<0.05), the least significant difference among means was calculated (Barr et. al, 1976). After sampling from each plastic can for analyzing the nutrient contents only the chick starters with 18% protein from the incubator were used in the feeding experiment for the investigation of chick performance. The composition of the basal diets which were used in the feeding experiment is presented in Table 1.

The experimental diets were fed ad libitum in mash form for 3 weeks, up to 28 days of age.

Table 1. Percentage composition of basal diet

Item	Composition(%)
Corn, yellow	36.0
Sorghum	9.0
Wheat	16.8
Soybean meal, 44%	16.8
Rapeseed meal	2.5
Wheat bran	6.37
Defatted rice bran	4.0
Fish meal, 62%	4.0
Limestone	1.2
Bone meal	2.0
Salt	0.2
Premix	1.13
Calculated analysis :	
Crude protein	18.0

Body weights were recorded weekly on an individual basis. Feed consumption data was obtained at weekly intervals on a group basis.

III. RESULTS AND DISCUSSION

The fat level and carotene content in the two diets with 18% and 12% protenin levels each were significantly (P<0.05) decreased when the diets were untreated by the mold inhibitor (Table 2).

Even if mold inhibitor was mixed in the diet, the fat content in the diet which had 40% of the particle in the less than 1.19mm tended to be decreased, especially, in the diet with a 12% protein level.

The carotene content in the diet treated with mold inhibitor which had 40% of the particles in the ratio less than 1.19mm also tended to be decreased in both diets (18% protein and 12% protein). Feed types×particle size interaction

Table 2. Effect of feed storage for 40 days on a few untritional components of chick ration

Treatments	Crude fat(%)		Carotene(mog/g)		Crude protein(%)		ADF(%)	
	18% * protein	12% protein	18% * protein	12% protein	18% protein	12% protein	18% protein	12% protein
HF[1)]	2.0[a]	1.8[a]	3.0[a]	3.1[a]	18.0	12.0	6.1	17.1
HT	1.9[a]	1.7[a]	2.8[a]	2.9[a]	18.1	12.3	6.1	17.2
HNT	1.0[b]	0.8[b]	2.1[b]	2.3[b]	18.3	12.2	6.2	17.2
LF	2.0[a]	1.8[a]	3.0[a]	3.1[a]	18.0	12.0	6.1	17.1
LT	1.8[a]	1.5[a]	2.5[ab]	2.5[ab]	18.2	12.2	6.0	17.1
LNT	1.1[b]	9.7[b]	2.0[b]	2.1[b]	18.2	12.0	6.1	17.0

1) H : 80% of the exprimental diet's particle size less than 1.19mm.
L : 40% of the experimental diet's particle size less than 1.19mm.
F : Fresh diet. T : Treated diet. NT : Untreated diet.
a-b Values with different superscripts within the 6 treatments are significantly different ($P<0.05$).
* Particle size × Feed types interaction was significnat($P<0.05$).

was significant for the fat content ($P<0.05$) and for the cartoene content($P<0.05$).

Bartov et al. (1982) reported that storing whole or ground samples of corn containing 13.0 % moisture did not affect fat and caroetene content, but the fat level and carotene concentration in wetted ground corn decreased markedly when the diet was kept inside a storehouse under natural temperatures (21 to 34℃) and natural relative humidity for 63 days storage. The greatest difference noted in the present study from the high relative humidity (85%) and constant temperature(29+1℃) of the current research.

Majumder et al. (1965) showed that moisture migration in sealed containers of grain as a result of temperature gradients encouraged microbial growth in the absence of a net gain in moisture. Increasing the moisture level of the grains cause mold development during the storage period and the negative effect of the moldy ground grains can be related, at least partly, to the decrease in fat and carotene content of the grains in storage(Bartov et. al., 1982).

The amount of crude protein and ADF was not significantly($P>0.05$) changed after 40 days storage. The results of total body weight gain, feed intake and feed efficiency during the experimental periods are summarized in Table 3. A significant decrease($P<0.05$) in total body weight gain and total feed intake was observed in chicks fed the untreated diet with 40% of the ration less than 1.19mm. Feed conversion was significantly ($P<0.05$) depressed in the chicks fed the untreated diet of both particle sizes.

Particle size×types of feed interaction in feed conversion was significant($P<0.05$).

In the current research, fat and carotene content of the diet containing the moldy grain untreated by mold inhibitor decreaased after 40

Table 3. Effect of poultry diets stored for 40 dyas treated or untreated with mold inhibitor on the performance of 28-day-old male chicks

Treatment	Body weight gain (g/chick)	Feed intake (g/chick)	Feed conversion* (feed/gain)
HF[1)]	666.7[b]	803.3[b]	2.33[b]
HT	655.8[b]	810.5[b]	2.34[b]
HNT	644.6[ab]	785.7[ab]	2.42[a]
LF	656.6[b]	813.4[b]	2.32[b]
LT	656.8[b]	793.4[b]	2.36[b]
LNT	633.3[a]	778.8[a]	2.39[a]

1) H : 80% of the exprimental diet's particle size less than 1.19mm.
L : 40% of the experimental diet's particle size less than 1.19mm.
F : Fresh diet. T : Treated diet.
NT : Untreated diet.
a-b Values with different superscripts within the 6 treatments are significantly different ($P<0.05$).
* Particle size × Feed types interaction was significnat($P<0.05$)

days storage. This decrease can explain, at least in part, the inferior performance of chicks fed the moldy grain(Bartov et al., 1982). Some nutritional deficiencies in the moldy grain can result in the retardation of growth and the prior utilization of feed, e.g., of the thiamine(Fritz et al., 1973) or lysine (Richardson et al., 1962), caused by the fungal infection of the grain.

Relative sizes of the liver, pancreas and spleen were not affected significantly ($P>0.05$) among the treatments (Table 4). Aflatoxin increased liver and pancreas weight(Smith and Hamilton, 1970 ; Doerr et al., 1983 ; Kimkool and Doerr, 1987 ; Yeoh, 1988) and spleen weight(Smith and Hamilton, 1970 ; Merkley et al., 1987). This toxin was detected in the rations used in this study after 40 days storage, which were untreated with mold inhibitor. The amount of aflatoxin in the untreated diet after 40 days storage was 6-7 ppb as was indicated in the first part of this research. The amount of aflatoxin that appeared in the present research diet might not be have been enough to show a increase in organ weight.

Table 4. Weight of livers, Kidneys and spleens of 28-day-old male chicks fed a 18% protein diet fermented for 40 days

Treatment	Liver weight (g/kg, B. Wt.)	Pancreas weight (g/kg, B. Wt.)	Spleen weight (g/kg, B. wt.)
HF[1)]	25.4	2.2	1.0
HT	24.9	2.0	1.0
HNT	25.1	2.1	1.0
LF	25.0	2.2	1.1
LT	25.4	2.1	1.0
LNT	24.0	2.2	1.1

1) H : 80% of the exprimental diet's particle size less than 1.19mm.
L : 40% of the experimental diet's particle size less than 1.19mm.
F : Fresh diet. T : Treated diet.
NT : Untreated diet.

IV. SUMMARY

The effect of mold inhibitor was determined in the commercial rations which had two different protein levels(18% and 12%) and two different particle sizes(80% of the particles in the ration less than 1.19mm and 40% of the particles in the ration less than 1.19mm). After 40 days storage of the rations treated and not trea-

ted with the mold inhibitor the nutritional change of the experimental diets with 18% and 12% protein levels, the growth performance of chicks, and the weight of internal organs fed the 18% protein diet were observed as the criteria of this research.

The fat level and carotene content in the two diets with 18% and 12% protein level each were significantly ($P<0.05$) decreased when the diets were not treated by the mold inhibitor. Even if mold inhibitor was mixed in the diet, the fat contnet in the diet which had 40% of the particles in the ration less than 1.19mm tended to be decreased, especially, in the diet with a 12% protein level.

The carotene content in the diet treated with mold inhibitor which had 40% of the particles in the ration less than 1.19mm also tended to be decreased in both diets (18% protein and 12% protein). Feed types × particle size interaction was significant for the fat content ($P<0.05$) and for the carotene content ($P<0.05$). The amount of crude protein and ADF was not significantly ($P>0.05$) changed after 40 days storage.

There was a significant decrease ($P<0.05$) in total body weight gain and total feed intake observed in chicks fed the untreated diet with 40 % of the particles in the ration less than 1.19 mm. Feed conversion was significantly ($P<0.05$) depressed in the chicks fed the untreated diet of both particle sizes. Particle size × types of feed interaction in feed conversion was significant ($P<0.05$). Relative sizes of the liver, pancreas and spleen were not affected significantly ($P>0.05$) by the treatments.

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