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# Effects of Granite Porphyry Supplementation on Growth Performance and Meat Sensory Quality in Broiler Chickens

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# 맥반석의 첨가 급여가 육계에서 성장성적 및 관능적 특성에 미치는 영향

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***ABSTRACT*** This experiment was conducted to investigate the influence of dietary supplementation of granite porphyry (GP) on growth performances and meat sensory quality in commercial broiler chicks. A total of four hundred-fifty 5-day-old male broiler chicks were divided into 15 pens and fed one of five experimental diets for 5 weeks; 0% GP with antibiotics (Control), 1% GP with or without antibiotics, and 2% GP with or without antibiotics. Final body weight and daily weight gain of all GP supplemented groups were slightly higher than those of control. Feed conversion rate was improved in GP 1% supplemented groups, although there was no significant difference. Feeding antibiotics in addition to GP did not influence the growth parameters. Relative weights of liver and abdominal fat tended to be reduced in broiler chickens fed GP supplemented diets. Feeding of 2% GP diet resulted in a significant improvement in meat sensory quality in terms of taste and tenderness($P < 0.05$), but the effect of the 1% GP on meat sensory quality was not significant. The results of this study indicate that GP could be used as a favorable feed additive for production of sensory-enhanced broiler meats.

(Key words: granite porphyry, antibiotics, growth performance, meat sensory quality, broiler chickens)

## INTRODUCTION

It has been suggested that dietary mineral sources and clays are related to reduced incidence of scours(Latif and Quisenberry, 1968; Sellers et al., 1980), intestinal diseases prevalent in young piglets(Mumpton and Fishman, 1977), and detrimental effects of aflatoxicosis(Huff et al., 1992; Kubena et al., 1993). Furthermore, supplementation of dietary minerals in poultry feeds improved growth rate and egg qualities in some cases. Broiler chickens fed zeolite showed significant improvement in body weight gain and feed conversion ratio(Willis et al., 1982). Miles et al.(1986) and Roland and Dorr(1989) reported that supplementation of synthetic sodium alumino silicate in commercial Leghorns significantly improved feed efficiency and egg specific gravity. Research workers in China studied dietary rare earth containing metallic elements of the lanthanide series in poultry and reported its beneficial effects on egg production, hatchability, growth rate, and product quality(Lei and Xueying, 1997). The authors suggested certain clays and mineral elements can be used as feed additives for improvement of animal health, and performance and protection of environment. Granite porphyry(GP, trade name MJ-Bio) used in this study is a complex and widely diverse family of aluminosilicate with various functional properties. Thus, it is expected that granite porphyry may be a useful feed additive to enhance animal health and production.

The objective of this study was to examine the influences of GP addition to feed on productivity and meat sensory quality

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in broiler chicks, and thus to evaluate its role as a growth promoter for substitution of antibiotics.

## MATERIALS AND METHODS

### 1. Animals and Diets

Four hundred-fifty male broiler chicks(Arbor Acres) were randomly housed in an open-sided broiler house(30 chicks per pen). At 5 days of age, all chicks were fed one of five experimental diets containing 0% GP with an antibiotic (auracin[1], chlortetracycline HCl 55g+Furaltadon HCl 40 g/kg), 1 or 2% GP supplemented diets with or without auracin, for 5 weeks. The ingredients and chemical composition of experimental diets are shown in Table 1. The experimental diets contained adequate levels of nutrients as recommended by the National Research Council(1994). GP was ground finely(325 mesh) and added at the expense of control diet at 1% or 2% levels on a weight basis. Auracin(AC), the water-soluble antibiotic, was selectively provided through trough waterers. The experimental diets and water were supplied *ad libitum* and the birds were raised according to the breeder's management manual.

### 2. General Procedures

All the birds were weighed at 20 and 35 days of the experiment on a replicate basis. Remaining feeds were weighed to determine feed consumption and feed conversion ratio. At the end of the experiment, two birds per replication were sacrificed and the liver and abdominal fat were immediately removed and weighed. Breast meats were also sampled to evaluate the chemical compositions and to compare sensory characteristics of meat. The moisture, crude protein, and ether extract were analyzed by the methods outlined by the AOAC(1990). Breast meats were also analyzed for cholesterol concentration using a colorimetric kit(Cholesterol-E test kit)[2], The sensory test was conducted by 10 trained panelists(graduate students at the Department of Animal Product Technology). After boiling in water for 30 min, cooking loss was measured. Boiled meats were cut into small pieces and presented randomly to the panelists. Preference scores were recorded based on flavor, taste, tenderness, and juiciness. A score of 10 represented

**Table 1.** Ingredients and chemical composition of experimental diets

| Ingredients | Starter diet | Finisher diet |
|---|---|---|
| | ---------- % ---------- | |
| Yellow corn | 35.80 | 37.00 |
| Wheat | 25.00 | 30.00 |
| Soybean meal | 16.20 | 13.90 |
| Rapeseed meal | 3.50 | 4.00 |
| Canola seed | 4.90 | 2.40 |
| Full fat soybean | 4.70 | 2.40 |
| Corn gluten meal | 3.00 | 3.20 |
| Limestone | 0.58 | 0.75 |
| Tricalcium phosphate | 1.64 | 1.30 |
| Sodium chloride | 0.24 | 0.24 |
| Tallow | 2.80 | 3.30 |
| Choline-Cl | 0.10 | 0.10 |
| DL-Methionine | 0.33 | 0.23 |
| L-lysine HCl | 0.26 | 0.23 |
| Vitamin mix[1] | 0.50 | 0.50 |
| Mineral mix[2] | 0.45 | 0.45 |
| Total | 100 | 100 |
| Calculated analysis | | |
| Crude protein, % | 19.94 | 18.04 |
| Ether extract, % | 5.33 | 5.37 |
| Crude ash, % | 6.18 | 5.83 |
| Ca, % | 0.88 | 0.81 |
| Available P, % | 0.44 | 0.37 |
| ME, kcal/kg | 3,002 | 3,050 |

[1] Vitamin mixture provided following nutrients per kg of diet: vitamin A, 15,600IU; vitamin $D_3$, 3,129IU; vitamin E, 15.6 mg; vitamin $K_3$, 0.91mg; vitamin $B_1$, 1.3 mg; vitamin $B_{12}$, 0.026 mg; niacin, 52 mg; oxystat, 65 mg; biotin, 0.039 mg, folacin, 0.39 mg; pyridoxine, 1.3 mg; riboflavin, 13 mg; pantothenic acid, 15.6 mg.

[2] Mineral mixture provided following nutrients per kg of diet: Mn, 77 mg; Zn, 57.2 mg; I, 1.32 mg; Se, 0.11 mg; Cu, 27.5 mg.

[1] Woojin Co., Ltd., Seoul, Korea.

[2] Yeongdong Pharmaceutical Corp., Seoul, Korea.

"Like extremely" , a 5 "Neither like nor dislike" and a 0 "Dislike extremely" .

### 3. Statistical Analyses

Data were analyzed by General Linear Models procedures of the SAS program(2002). Treatment means were compared by Duncan's multiple range test when the treatment F-test was significant($P < 0.05$).

## RESULTS AND DISCUSSION

Daily weight gain, feed intake and feed conversion ratio in broiler chicks fed the experimental diets are shown in Table 2. Daily weight gains of all GP supplemented groups were slightly higher than those of the control. Feed intake was not altered by inclusion of GP. Feed conversion ratio at 35 days of experiment did not significantly vary among the treatment groups, ranging from a low of 1.83 for the 1% GP group without AC to a high of 1.88 for the control and 2% GP without AC groups. Overall, the addition of GP in combination with or without AC did not influence growth parameters, indicating GP may be used as a substitute for antibiotics.

There are some indications that various mineral sources improve feed conversion ratio and growth performance. Willis et al.(1982) reported that the addition of 2% and 3% zeolites in broiler rations significantly increased body weights without affecting feed conversion ratio. Roland and Dorr(1989) also demonstrated that supplementation of synthetic sodium aluminosilicate in commercial Leghorns significantly improved feed efficiency. However, the results are not always conclusive. According to Sellers et al.(1980), who studied the dietary effects of various fillers and clays in broiler chickens, body weight gain, and feed consumption were not affected by mineral sources. Lee(1975) observed that feeding of 4% bentonite or zeolite, at the expense of basal concentrate, slightly increased body weight gain.

The mechanism, which is responsible for increase in weight gain and/or feed conversion ratio, may be related to elevated utilization of energy and nutrients. Several investigators have noted that the use of mineral materials and clays in poultry rations may have enhanced feed utilization by slowing passage rate of feeds through the digestive tract, thus allowing for greater digestion and absorption(Qusterhout, 1967; Hams and Damron, 1973). Further study is required to clarify the effect of GP supplementation on energy and nutrient availabilities.

The effects of GP supplementation on the weights of the liver, abdominal fat, breast meat, and legs are presented in Table 3. Liver weight at 20 days and 35 days did not vary significantly among the groups. At 35 days of the experiment, abdominal fat weight of all GP supplemented groups decreased in comparisons with control group although it did not show significant difference. Breast meat and leg weights were not affected by dietary treatment. These results clearly indicate that dietary supplementation of GP to broiler rations at 1% and 2% levels does not negatively affect organ weights and edible meat production.

There were no differences in the concentrations of moisture, crude protein, and ether extract in breast meats among treated groups(data not shown). Cholesterol concentration in breast meats did not significantly vary among the treatment groups, ranging from a low of 105.60 mg/100 g for the 1% GP group without AC to a high of 111.60 mg/100 g for the 2% GP group without AC(data not shown).

Table 4 shows the results of cooking loss and meat sensory quality. Cooking loss was not affected by dietary inclusion of

Table 2. Effects of granite porphyry supplementation on daily weight gain, feed intake and feed conversion ratio in broiler chickens*, **

| | Control | GP 1%(AC-) | GP 1%(AC+) | GP 2%(AC-) | GP 2%(AC+) |
|---|---|---|---|---|---|
| Daily weight gain, g/day /bird | 52.55±0.54 | 54.81±0.47 | 53.21±2.15 | 53.78±1.97 | 55.16±1.43 |
| Feed intake, g/day /bird | 98.91±0.97 | 100.48±0.92 | 98.22±2.33 | 101.03±2.46 | 102.94±1.61 |
| Feed conversion ratio | 1.88±0.00 | 1.83±0.03 | 1.85±0.03 | 1.88±0.05 | 1.87±0.02 |

* GP, granite porphyry; (AC-), without antibiotic; (AC+), antibiotic supplementation.

** Values are presented means±SE.

**Table 3.** Effects of granite porphyry supplementation on relative weights of liver, abdominal fat, breast meat and leg in broiler chickens*, **

| | Control | GP 1%(AC-) | GP 1%(AC+) | GP 2%(AC-) | GP 2%(AC+) |
|---|---|---|---|---|---|
| 20 days of experiment | | | | | |
| Liver wt, g/ 100g BW | 3.19±0.18 | 2.70±0.11 | 2.83±0.15 | 2.90±0.17 | 2.99±0.13 |
| Abdominal fat wt, g/100g BW | 1.48±0.11 | 1.35±0.09 | 1.52±0.14 | 1.28±0.10 | 1.29±0.11 |
| Breast meat wt, g/100g BW | 6.52±0.11 | 6.20±0.14 | 6.39±0.14 | 6.51±0.35 | 6.82±0.27 |
| Leg wt, g/100g BW | 9.14±0.25 | 9.49±0.14 | 9.65±0.09 | 9.20±0.19 | 9.24±0.20 |
| 35 days of experiment | | | | | |
| Liver wt, g/100g BW | 2.67±0.22 | 2.60±0.19 | 2.64±0.04 | 2.51±0.09 | 2.83±0.15 |
| Abdominal fat wt, g/100g BW | 2.16±0.22 | 1.74±0.15 | 1.96±0.19 | 1.79±0.20 | 1.75±0.19 |
| Breast meat wt, g/100g BW | 6.37±0.17 | 6.34±0.28 | 6.18±0.23 | 6.57±0.20 | 6.68±0.31 |
| Leg wt, g/100g BW | 8.67±0.28 | 8.39±0.13 | 8.39±0.26 | 8.44±0.18 | 8.06±0.06 |

* GP, granite porphyry; (AC-), without antibiotic; (AC+), antibiotic supplementation.

** Values are presented means±SE.

**Table 4.** Effects of granite porphyry supplementation on cooking loss, meat flavor, taste, tenderness and juiciness in broiler chickens*, **, ***

| | Control | GP 1%(AC-) | GP 1%(AC+) | GP 2%(AC-) | GP 2%(AC+) |
|---|---|---|---|---|---|
| Cooking loss, % | 14.62±0.69 | 13.18±0.77 | 13.91±0.41 | 12.55±0.68 | 13.34±0.64 |
| Meat sensory quality | | | | | |
| Flavor | 7.33±0.82 | 7.28±0.57 | 7.81±0.41 | 7.89±0.49 | 7.39±0.62 |
| Taste | 7.08±0.60$^{b}$ | 7.03±0.51$^{b}$ | 7.53±0.35$^{ab}$ | 7.94±0.42$^{a}$ | 7.81±0.54$^{a}$ |
| Tenderness | 7.50±0.69$^{c}$ | 7.39±0.59$^{c}$ | 7.72±0.16$^{b}$ | 8.39±0.47$^{a}$ | 8.17±1.25$^{ab}$ |
| Juiciness | 7.50±0.51$^{abc}$ | 7.14±0.49$^{c}$ | 7.44±0.44$^{bc}$ | 8.06±0.38$^{a}$ | 8.00±0.58$^{ab}$ |

$^{a-c}$ Means with different superscripts in the same row differ significantly($P < 0.05$).

* GP, granite porphyry; (AC-), without antibiotic; (AC+), antibiotic supplementation.

** Values are presented means±SE.

*** A score of 10 represented "Like extremely", a 5 "Neither like nor dislike" and a 0 "Dislike extremely".

GP. The dietary supplementation of GP resulted in a large improvement in meat sensory score, in which feeding the 2% GP supplemented diet significantly($P < 0.05$) improved meat taste, tenderness, and juiciness in comparisons with other groups.

Since mineral sources and clays have been used for years to reduce the malodor of animal wastes, one area of concern is the ability of GP to control meat sensory qualities. Meat sensory quality was greatly affected by GP supplementation. Particularly, feeding of 2% GP resulted in a significant improvement in meat sensory quality in terms of taste and tenderness. Because available information on meat sensory quality in broiler chickens is extremely limited, the interpretation of the present result has remained difficult. Additional research is necessary to elucidate the effects of GP supplementation to broiler rations on meat quality.

In conclusion, growth performance was slightly improved by GP supplementation regardless of addition of AC. No effects were found on carcass characteristics. The results from this study indicate that GP may be used not only as a substitute for

antibiotics to promote growth performance, but also as a favorable feed additive to produce sensory-enhanced broiler meats.

## 적 요

본 실험은 육계사료 내에 맥반석 분말을 첨가 급여했을 때 육계의 성장에 미치는 효과와 생산된 계육의 관능적 품질에 미치는 영향을 조사하기 위하여 실시하였다. 5일령 Avian 육계 수평아리를 반복별로 체중이 동일하도록 임의배치하였다. 맥반석 분말을 첨가하지 않은 대조구에 맥반석 분말을 1% 및 2% 수준으로 첨가한 처리구를 두었으며, 각각의 처리구 내에는 항생제 음수 투여구와 무투여구를 두어 5처리에 3반복, 반복당 30수씩 총 450수를 공시하여 30일간 실험사료를 급여하였다. 실험기간 중의 사료섭취량 및 증체량을 조사하여 사료요구율을 구하였고, 5주령에 각 반복구 내에서 체중의 평균치에 해당하는 개체를 2수씩 선발하여 희생시킨 후 필요 조직을 채취하였고, 근육 내의 화학적 조성과 육질 평가를 실시하였다. 종료 시 체중 및 증체량은 대조구에 비해 맥반석 분말을 첨가 급여한 처리구에서 다소 증가하는 경향을 나타내었다. 맥반석 분말 1% 첨가구에서 사료 요구율이 개선되었으나, 유의한 차이는 아니었다. 단위체중당 간 중량 및 복강지방 중량은 맥반석 분말의 첨가 급여에 의해 다소 감소하는 경향을 보여 주었다. 맥반석 분말 2% 첨가구에서 가슴근육의 중량이 가장 높았으며, 다리근육 중량은 반대로 낮아지는 경향이 관찰되었으나 통계적인 유의차는 인정되지 않았다. 관능검사 결과에서는 대조구에 비해 맥반석 분말 1% 첨가구에서는 첨가 효과가 나타나지 않았으나, 맥반석 분말 2% 첨가구에서는 맛, 연도 및 다즙성의 전 항목에 걸쳐 유의하게 높아지거나 높아지는 경향을 보여 주었다.

(색인어: 맥반석 분말, 항생제, 성장 성적, 관능적 육질, 육계)

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