Effect of Dietary Mineral Levels and Feeding Molasses on the Incidence of Loose Droppings in Chickens

By SADANOBU HIJIKURO

Animal Nutrition Division, National Institute of Animal Industry

One of the problems in feeding and management of chickens under high temperature environment in the summer season is the incidence of loose droppings[1]. To decrease the drying and other handling cost, and nasty odor of chicken manure, it is highly desirable to prevent the occurrence of loose droppings. For that purpose, factors related to the occurrence have to be made clear but so far only few studies have been done.

Although excess of sodium (Na) and potassium (K)[2], and feeding molasses[3-5] are known as the dietary factors which cause loose droppings, it can be said that the problem is not yet made fully clear. Therefore, in an attempt to clarify factors causing loose droppings from the standpoint of dietary composition with an aim of preventing them, the author carried out a study on the effect of deficiency or excess of Na, addition of K or magnesium (Mg) to the conventional ration, and the feeding of molasses on water consumption of chickens, and moisture content of feces or droppings.

Effect of dietary sodium and potassium excess on water consumption, urine excretion and moisture content of feces of chickens[6]

Although loose droppings are considered to occur by an increased urine excretion due to the increased water consumption, it has not been made clear to what extent the quantity of water intake effects on urine excretion and on moisture content of feces, because urine and feces are excreted in a mixture in case of chickens. Therefore, it was made possible to sample urine and feces separately by the use of chickens with artificial anus attached by a surgical operation. With growing chickens and adult male chickens, kept in a controlled temperature room at 20°C, effect of excess supply of Na, K, and both of them on water consumption, quantity of urine excreted and moisture content of feces was examined.

1) Experiment with high-Na diets

By adding NaCl to diets at the rate of 0.5 (approximately standard level), 1.25, 2.0 and 2.75%, the total Na level of diets was made to be 0.3, 0.6, 0.9, and 1.2%, respectively. The diets thus prepared were supplied to growing chickens with artificial anus, and quantity of water intake and urine excretion were measured. As shown in Fig. 1, excess supply of Na caused significant increases in water consumption and urine excretion, almost proportional to the quantity of NaCl added.

2) Experiment with high-Na and high-K diets

Four different diets with 0.25 and 1.8% total Na (supplemented in the form of NaCl) combined with 0.7% (originally contained in the feed materials) and 2.1% total K (added in the form of K_2SO_4), and a diet with 1.0%

Table 1. Effect of dietary sodium and potassium excess on water consumption, urine excretion and moisture content of feces in adult male chickens

Dietary Na (%)			0.25	0.25	1.8	1.8	1.0
Dietary K (%)			0.7	2.1	0.7	2.1	1.4
Water consumption (g)	range		138–149	161–190	278–336	272–371	178–267
	average		144[a1)]	177[b]	306[e]	320[e]	215[b]
Urine excretion (g)	range		42–46	72–77	155–184	163–228	92–114
	average		43.7[a]	74.0[b]	177.9[d]	194.1[d]	100.5[c]
Moisture content of feces (%)	range		67.5–71.1	76.7–82.5	78.8–80.5	73.8–82.8	75.0–79.3
	average		68.9[a]	80.1[c]	79.6[c]	78.1[b,c]	76.6[b]

1) Means not bearing the same superscripts are significantly ($p<0.05$) different

total Na and 1.4% total K were supplied to adult male chickens. Water consumption, urine excretion and fecal moisture were measured.

As shown in Table 1, it was made clear that excessive supply of Na, K or both of them caused significant increases in water consumption, urine excretion and fecal moisture as compared to those with the standard feed. Relationship between water consumption (X) and urine quantity (Y) is expressed by a linear equation, $Y=-76.38+0.84X$, showing a high significant correlation.

Both Na content of 1.8% and K content of 2.1% correspond to 12–13 times of each requirement (Na 0.15%, K 0.16%), but the former caused much more increases in water consumption and urine excretion than the latter, indicating that the excess of Na is more serious than excessive K in causing loose droppings. Addition of K to excessive Na diets showed no effect to decrease water consumption and urine excretion, but rather increased them.

Moisture content of feces (not mixed with urine) also increased significantly by the excess of Na, K, or both, reaching 80% at the maximum. However, no significant correlation was observed betwen fecal moisture and water consumption.

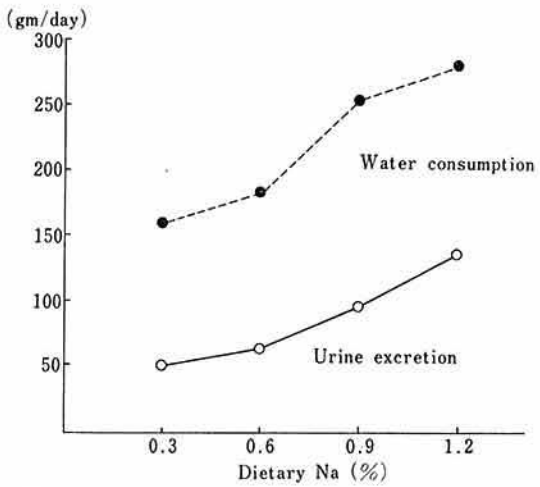

Fig. 1. Effect of dietary Na excess on water consumption and urine excretion of growing pullets with an artificial anus

Effect of dietary Na deficiency, or Na, K, and Mg excess on water consumption and moisture content of droppings

1) Experiment with broilers

Broilers of 6 weeks of age were kept in batteries in a loose house under high temperature and high humidity of the late August, and the following 8 different diets were supplied. NaCl was added at the rate of 0.2, 0.4, 0.8 and 1.6% (making the total Na content of diet as 0.12, 0.22, 0.33, and 0.64%, respectively) and each Na level was combined with 0 and 1.5% K_2SO_4 addition (total K content of feed was made to be 0.78 and 1.42%). Effect of these supplemental Na and K on water consumption and moisture content of

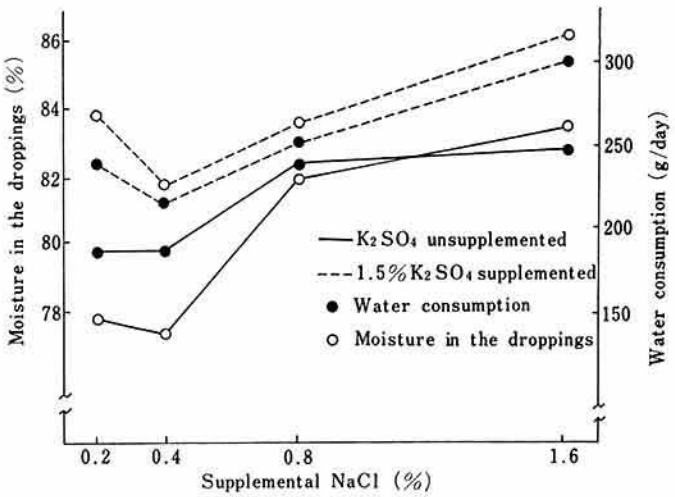

Fig. 2. Effect of supplemental NaCl and K_2SO_4 on water consumption and moisture content in the droppings of broilers

droppings is shown in Fig. 2.

Irrespective of with or without K_2SO_4 addition, the water consumption and moisture content of droppings showed a tendency to increase with Na-deficient diet (0.2% NaCl added: containing about 1/2 of the proper amount of Na) over the standard diet (0.4% NaCl added), and they increased significantly in proportion to the increase of supplemental Na, resulting in severe loose droppings with 1.6% NaCl. At any level of NaCl, the addition of K_2SO_4 also increased significantly the water consumption and moisture content of droppings.

2) Experiment with White Leghorn chicks

To confirm the above result obtained with broilers, a further experiment was conducted with White Leghorn starting chicks. In this experiment, 12 different diets were prepared by combining 0.19, 0.38, 0.57 and 0.76% of NaCl addition (0.09, 0.18, 0.28 and 0.35% in total Na content, respectively) with 0, 0.89 and 1.78% of K_2SO_4 (1.0, 1.4, and 1.8% in total K content). At the 4th week of feeding (at the rainy season so-called "Bai-u" in mid-June), water consumption and moisture content of droppings were measured.

Results obtained were quite similar to those of broilers. Namely, the more the excessive Na, and the more the addition of K_2SO_4, the more was the water consumption with a proportional increase in moisture content of droppings. Severe loose droppings were observed with high-Na and high-K diets.

Effect of Mg addition to the standard diet (with 0.38% NaCl added) was also examined with White Leghorn starting chicks. $MgSO_4$ was added at the rate of 0, 1.0 and 3.0% (which made the total Mg level of the diets to be 0.26, 0.44 and 0.80%, respectively), and at the fourth week of feeding, water consumption and moisture content of droppings were determined. The result showed, as given in

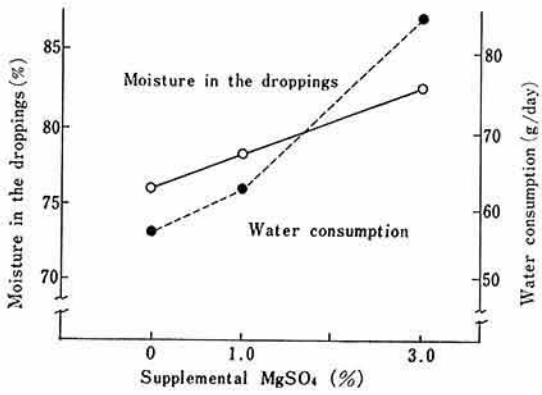

Fig. 3. Effect of supplemental $MgSO_4$ on water consumption and moisture content in the droppings of chickens

Table 2. Effect of dietary molasses levels on water consumption and moisture content in the droppings of laying hens

Dietary molasses (%)	Dietary Na (%)	Dietary K (%)	Water consumption (g/day)	Moisture in the droppings (%)
0 (control)	0.21	0.65	148[a1)]	77.9[a]
3	0.23	0.70	164[a]	80.8[a,b]
6	0.27	0.74	171[a]	81.5[b]
12	0.29	0.87	217[b]	82.3[b]

1) Means not bearing the same superscripts within a colum are significantly ($p<0.05$) different

Fig. 3, that the addition of $MgSO_4$ caused the increase in water consumption and moisture content of droppings, resulting in severe loose droppings in the 3.0% $MgSO_4$ group.

A series of experimental results presented above demonstrates that either deficiency or excess of Na in diets causes loose droppings. As the total Na level in diets at the rate of 0.15% is sufficient, addition of NaCl at 0.4% is good enough. Cares be taken not to supply Na beyond this level. With the practical ration, both K and Mg are contained more than enough, and hence there is no need of supplemental supply of them.

Effect of feeding molasses to laying hens on their water consumption and moisture content of droppings

Laying hens kept in a controlled high temperature room (30°–33°C) were fed the standard diet (with NaCl added at 0.4%) to which molasses were added at the rate of 0, 3, 6 and 12% (0.21, 0.23, 0.27, and 0.29% as total Na levels respectively, and 0.65, 0.70, 0.74 and 0.87% as total K levels, respectively).

As shown in Table 2, with the increase in supplemented molasses water consumption and moisture content of droppings increased. Addition of molasses at 12% caused a significant increase in water consumption over that of standard diet (control group), and molasses added at the rate higher than 6% increased moisture content of droppings significantly over the control.

It was reported[5)] that a large amount of K contained in molasses was responsible for the occurrence of loose droppings due to molasses. Therefore, a comparative experiment was carried out using the standard diet with 12% molasses and that with 0.6% K_2SO_4, which has a similar K level to the former. As the occurrence of loose droppings was not observed by the addition of K_2SO_4 at 0.6%, it is considered that molasses might contain some unidentified substances which cause loose droppings in addition to K. Further investigation is needed on this aspect.

References

1) Okamoto, S.: "Environment and Physiology in Domestic Animal", 102, Yokendo, Tokyo (1970) [In Japanese].
2) Kondo, A. K. & Ross, E.: The effect of certain ionic interactions on water metabolism of chicks. *Poultry Sci.*, 41, 1132–1136 (1962).
3) Rosenberg, M. M. & Palafox, A. L.: Effect of certain cations in cane final molasses on fecal moisture of chicks. *Poultry Sci.*, 35, 682–686 (1956).
4) Cuervo, C. et al.: The sugars and various cations present in cane molasses and their effect on diarrhea in chickens. *Poultry Sci.*, 51, 813–820 (1972).
5) Cuervo, C. H., Bushman, H. & Santos, E.: The effect of deionization and drying of cane molasses on their laxative action in chickens. *Poultry Sci.*, 51, 821–824 (1972).
6) Hijikuro, S.: Effect of dietary sodium and potassium excess on water consumption, urine excretion and moisture content of feces of chickens. *Jap. Poultry Sci.*, 13, 37–42 (1976).