Pakistan Vet. J., 2009, 29(4): 165-168.

RESPONSE OF BROILER CHICKS TO DIETARY MONOSODIUM GLUTAMATE

KHADIGA, A. A. ATI, S. MOHAMMED, A. M. SAAD[1] AND H. E. MOHAMED[2]

Faculty of Animal Production; [1]Faculty of Veterinary Medicine, University of Khartoum, Khartoum North, Sudan;
[2]Department of Animal Production, College of Food and Agricultural Sciences,
King Saud University, Saudi Arabia

ABSTRACT

The objective of this study was to assess the effect of monosodium glutamate (MSG) on broiler performance, blood chemistry and the brain tissues. A total of 120 day-old Lohman broiler chicks were randomly divided into four groups, with 3 replicates (30 birds per treatment). Four approximately isonitrogenous and isocaloric diets with different levels of MSG viz. 0, 0.25, 0.5 and 1.0% were formulated. Feed and water were provided *ad libitum* throughout the experimental period of 49 days. The results revealed that total feed intake was significantly higher ($P<0.05$) in chicks fed 1% MSG compared to other three groups. Final body weight gain was significantly ($P<0.05$) lower in chicks fed 0.25 and 0.5% MSG compared to control group. Feed conversion ratio, serum total proteins and cholesterol levels were not affected by the dietary treatments. Serum lipids level decreased significantly ($P<0.01$) by dietary MSG. Significant increase ($P<0.01$) in serum uric acid level was observed in birds fed 0.5% MSG. Light microscopic examination of brain sections showed histopathological lesions in midbrain and cerebellum in birds fed 1% MSG. Midbrain sections showed neuron angulations, chromatolysis, fibrolamellation and gliosis. Cerebellum sections showed spongy degeneration and haemorrhagic foci. It was concluded that high level of MSG (1%) has adverse effects on the nervous tissue of broiler chicks.

Key words: Monosodium glutamate, serum, biochemistry, brain tissue, broilers.

INTRODUCTION

Monosodium-L-glutamate (MSG) is a food additive, which serves as a useful flavor enhancer. It has been widely used for many years in human and livestock diets to promote consumption rates of a particular feed item (Solon *et al*., 1985). Its use has increased throughout the world in recent years as flavoring in cooking (Chaudari and Roper, 1998) to increase palatability and food selection in a meal (Bellisle *et al*., 1996). Recently in Sudan, utilization of MSG is increased extensively among the Sudanese families as food additive to enhance flavor and as a substitution of the high meat cost.

MSG treated animals had increased triacylglycerol levels, hypertriglyceridemia (Diniz *et al*., 2005), lipoperoxidation and alteration in markers of oxidative stress lipoperoxidation (Jiang *et al*., 1991). MSG treated rats had an imbalanced oxidant/antioxidant system and enhanced oxidative stress. MSG can be markedly toxic to the central nervous system of laboratory animals (Olney and Sharp, 1969). MSG has been shown to increase serum total proteins, cholesterol and blood glucoses levels in mice (Osfor *et al*., 1997). The objective of the present research was to study the effects of dietary MSG on performance, general health, and serum biochemistry in broiler chicks.

MATERIALS AND METHODS

A total of 120 one-day-old unsexed commercial broiler chicks (Lohman) were used in this experiment. The chicks were weighed and randomly distributed into 12 pens (each pen contained 10 birds of approximate equal body weight). The pens were then randomly allocated to four experimental diets with 3 replicates (30 birds per treatment) for a period of 49 days. Four experimental diets were formulated to meet or slightly exceed the nutrient requirements of broiler chicks (Table 1). The experimental diets were approximately isocaloric-isonitrogenous and were similar in all other aspects except in the four levels of MSG (0.00, 0.25, 0.50 and 1.00%). Data on feed consumption, weight gain and feed conversion ratio (FCR) were recorded weekly.

At the end of the trial, two birds from each replicate (6 per treatment), were slaughtered. Blood was collected for serum, which was stored at -20ºC for the chemical analysis.

Serum samples were analyzed for total proteins (Weischselbaum, 1946), serum lipids (Frings and Dunn, 1970), cholesterol (Richmond, 1973) and uric acid (Trinder, (1969). Brain tissues were removed from head after slaughter, fixed in 10% formal saline, embedded in paraffin, sectioned and stained with haematoxyline and eosin for histopathological studies.

Table 1: Composition of experimental diets fed to broiler chicks

Ingredients	Amount (%)			
Sorghum	60.00	59.80	59.55	59.05
Groundnut	17.00	17.00	17.00	17.00
Sesame	10.00	10.00	10.00	10.00
Wheat bran	5.00	5.00	5.00	5.00
Concentrate*	6.00	6.00	6.00	6.00
Salt	0.25	0.20	0.20	0.20
Min/vitamin	0.50	0.50	0,50	0.50
Oyster shell	1.25	1.25	1.25	1.25
Monosodium glucomate	0.00	0.25	0.50	1.00
Total	100	100	100	100

* Chemical constituents for broiler super concentrate in %; Crude protein 33.0, lysine 12.1, methionine 2.74, meth + lysine 2.35, calcium 8.1, phosphorous 5.6 and ME 1720 Kcal/kg. Calculated CP 2205%, CF 4.16%, ME 3010.54 Kcal/kg, Ca 1.27%, P 0.77%, L- lysine 1.585%, methionine 0.423%.

A complete randomized design was used and data were subjected to statistical analysis according to Steel and Torrie (1980). Duncan's multiple range test was used to compare the treatment means.

The experiment underwent ethical review and was given approval by the ethics committee of the Faculty of Animal Production, University of Khartoum. The care and use of broiler chicks complied with local animal welfare laws, guidelines and policies.

RESULTS

In the present study, experimental birds looked apparently in a good heath without any nervous symptoms. The inclusion of 1% MSG significantly ($P<0.5$) increased feed intake of birds compared to other groups (Table 2). On the other hand, no differences were recorded in body weight gain in birds fed 1% MSG and the control group. However, body weight gain significantly ($P<0.05$) decreased in chicks fed 0.25 and 0.5% MSG compared to control. Moreover, feed conversion ratio was not affected by the treatments.

Dietary MSG had no effect on serum total proteins and cholesterol (Table 3). However, it had resulted in reduction of serum lipids, while serum uric acid level increased by feeding 0.5 MSG compared to control group ($P<0.01$).

Histopathological findings of the brain sections of broilers fed 1% MSG showed neuron angulation (Fig. 1). These were characterized by shrinkage of the neuron body, leaving a distinct surrounding space, filrolamellation, and degeneration (Fig. 2) and gliosis in the midbrain. Cerebellum sections showed spongy degeneration and haemorrhages (Fig. 3).

DISCUSSION

The significant increase in feed intake of chicks given 1% MSG diet may indicate that MSG was palatable and accepted by the birds. Similar responses were reported by Tanaka *et al.* (1983) and Reddy *et al.* (1986). Addition of 1% dietary MSG resulted in body weight gain similar to the control group. However, body weight gain decreased significantly in chicks fed 0.25 or 0.50% MSG compared to control. Feed conversion ratio was not influenced by dietary MSG. These findings are similar to those obtained by Mohammed (1994). Treatment with MSG has no effect on serum total proteins and c holesterol, which supports the findings of Ahluwalia and Malik (1989).

Betran *et al.* (1992) reported that total serum lipids increased in MSG treated rats which were not seen in the present study. Serum uric acid levels increased by feeding 0.5 and 1% MSG, which is in line with the findings of Osfor *et al.* (1997), who elucidated adverse effects of MSG in the form of heavy urate deposition on visceral organs and subsequent death of chicken.

The lesions in the brain associated with feeding a high level of MSG in this study may be due to accumulation of glutamic acid in the brain tissue. In broiler chicks, Elrayah (1995) reported different stages of neuron necrosis in mid brain and malacia in the cerebellum in chicks fed low protein diet and supplemented with MSG.

Table 2: Effects of dietary MSG levels on overall performance of broiler chicks

Parameter	MSG levels (%)				
	0.00	0.25	0.50	1.00	± SE
Total feed intake (g/bird)	3958.43^{b}	3942.83^{b}	3864.83^{b}	4141.10^{a}	34.66
Total weight gain (g/bird)	1907.73^{a}	1751.50^{b}	1751.16^{b}	1861.27^{ab}	36.55
Feed conversion ratio	2.09^{a}	2.26^{a}	2.25	2.28^{a}	0.08

SE:- Standard error of the means; ^{ab} Values in the same row with different superscripts differ significantly ($P<0.05$).

Table 3: Effects of dietary MSG levels on serum constituents of broiler chicks

Parameter	MSG levels (%)				
	0.00	0.25	0.50	1.00	± SE
Total proteins (g/100 ml)	2.98[a]	3.22[a]	3.54[a]	3.53[a]	0.05
Lipids (mg/100 ml)	405.11[a]	270.70[b]	228.07[b]	251.27[b]	18.10
Cholesterol (mg/100 ml)	136.94[a]	130.84[a]	131.07[a]	138.75[a]	9.74
Uric acid (mg/100 ml)	5.60[bc]	5.25[c]	7.91[a]	7.50[ab]	0.12

SE:- Standard error of means; [ab] Values in the same row with different superscripts differ significantly (P<0.01).

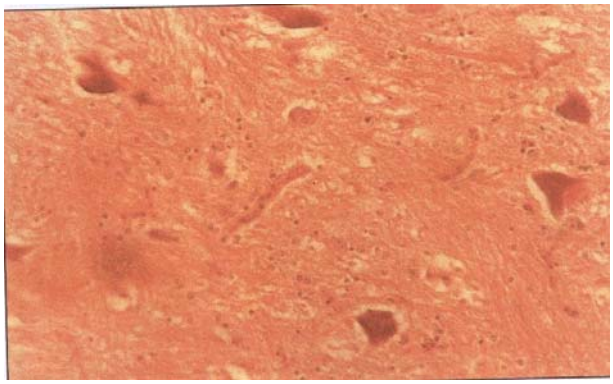

Fig. 1: Neuronal angulation in the midbrain of broiler chicks fed 1% dietary MSG (H & E).

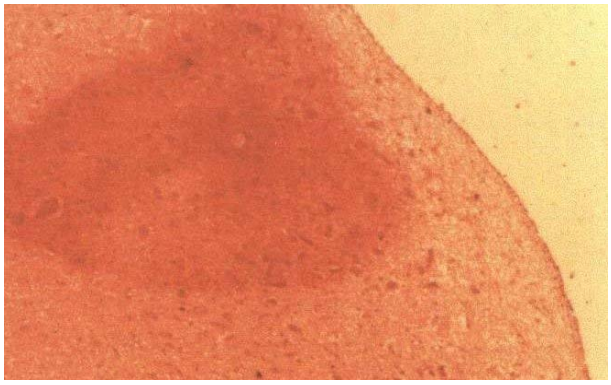

Fig. 2: Fibrolamellation and neuronal degeneration in the midbrain of broiler chicks fed 1% dietary MSG (H & E).

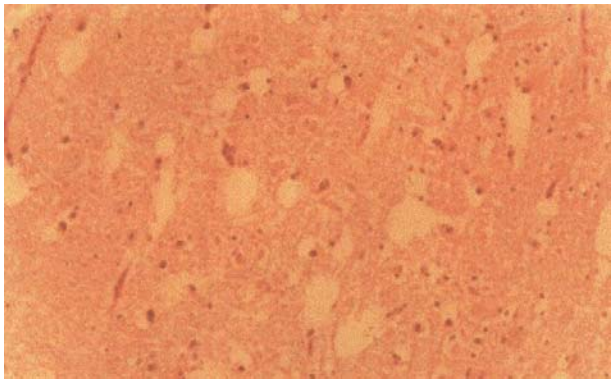

Fig. 3: Haemorrhages in cerebellum of broiler chicks fed 1% dietary MSG (H & E).

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