Journal of Veterinary and Animal Sciences. 28 (1997) 19-24

INFLUENCE OF ISOPROTERENOL ON PLASMA AND BODY PROTEINS AND LIPIDS IN BROILERS

P. Hariharan and S. Gowrishanker
Department of Pharmacology and Toxicology, Madras Veterinary College, Madras - 7

The outcome of genetic improvement, nutritional research and Pharmacological manipulation in broilers have resulted in faster growth accompanied by excessive fat deposition. The relatively small change in feed conversion ratio which has accompanied the large change in growth rate may be seen as an indirect evidence of increased fat deposition.

Health conscious consumers have become increasingly aware of the health quality of the food they consume. Lipid composition in particular has been a primary area of consumer concern due to an increased awareness of the link between the amount and composition of the fat in the human diet and the development of Coronary heart disease and certain forms of cancer. Attempts to decrease carcass fat and increase carcass protein by Pharmacological manipulation has been reported (Hargis *et al.*, 1988). Hence an attempt was made in this study to find out the effect of isoproterenol on plasma and body proteins and lipids in broilers and its capacity for lean meat production.

Materials and methods

Day old broiler chicks of ross strain obtained from a commercial hatchery were used for this study. They were sexed on day 1 and separated into male and female and kept in separate breeders. They were weighed and numbered by using wing bands. For the first 14 days the chicks were kept in brooders and on the 15th day they were transferred to individual cages. On day 1 the birds in each sex were divided into three groups of six birds each. Feed and water were provided ad libitum. As per the approved managemental practices broiler starter mash was provided from day 1 to day 28 and broiler finisher mash was provided from day 29 to 42.

Feed was provided at 10.00 AM. daily. Next day before giving feed, the feed left in the feeder was weighed and feed consumed by each bird was calculated to record daily feed intake and cumulative feed intake.

Isoproterenol was dissolved in normal saline and injected subcutaneously from day 15 to day 45 daily at 10.00 A.M. at two different (group B and C) dosage levels (0.15 mg/kg and 0.30 mg/kg body weight). The birds were weighed individually daily and daily weight gain and cumulative weight gain were recorded. Feed efficiency was also calculated.

Blood was collected initially on 14th day before the start of drug administration for estimation of serum lipase titrimetrically (Roe and Byler, 1963). For other biochemical estimations blood was collected in test tubes containing EDTA. The blood samples were cooled by placing them on ice following collection and the plasma was separated by centrifugation at 1000g for 10 minutes. Plasma triglyceride was estimated

by enzymatic method (Bucolo and David, 1978), total serum protein was estimated by modified Biuret and Dumas method (Varley *et al.*, 1980) using span diagnostic kit. LDL cholesterol was calculated using Friedewald's equation (Friedewald *et al.*, 1972). Total body protein (Carcass Protein) and total body lipid (carcass lipid) was estimated using the standard procedure of A.O.A.C. (1980).

The results were analysed by analysis of Variance using completely randomized block design (Snedecor and Cochran, 1989).

Results and discussion

In this study isoproterenol at 0.15 and 0.30 mg/kg did not significantly alter the cumulative feed intake in males. In females the higher dosage increased the cumulative feed intake (Table 1).

Cumulative weight gain was increased by both the dosage used in both sexes. The increase in cumulative weight gain was more in males (Table 1).

Hargis *et al.* (1988) have demonstrated that in ovo administration of isoproterenol significantly increased the weight gain in broilers. Mallov (1973) observed that this drug had a greater effect on increasing protein synthesis than epinephrine and norepinephrine and he suggested that interaction with beta receptors was responsible for the alteration in rate of protein synthesis.

Table 1 Effect of Isoproterenol on cumulative feed intake, cumulative weight gain and cumulative feed efficiency in broilers

Treatment	Cumulative feed intake (g) (Mean±SE)		Cumulative weight gain (g) (Mean±SE)		Cumulative feed efficiency (Mean±SE)	
	Male	Female	Male	Female	Male	Female
Control (A)	2128.33± 15.79	2055.83^{b}± 43.79	1136.67^{c}± 25.86	1116.67^{c}± 22.56	1.88^{a} ± 0.05	1.84^{a} ± 0.04
Isoproterenol 0.15 mg/kg (B)	2120.00± 18.44	2147.50^{ab}± 2.26	1228.33^{b}± 25.07	1227.50^{b}± 24.57	1.73^{b}± 0.04	1.76^{ab}± 0.03
Isoproterenol 0.30 mg/kg (C)	2161.67± 19.70	2230.83^{a} ± 11.39	1337.50^{a}± 27.98	1302.14^{a} ± 19.84	1.62^{b} ± 0.04	1.70^{b} ± 0.03

Means bearing different superscripts differ significantly ($P < 0.05$)

Table 2 Effect of isoproterenol on biochemical parameters in broilers

	Parameter	Treatment	4th week		5th week		6th week	
			Male (Mean±SE)	Female (Mean±SE)	Male (Mean±SE)	Female (Mean±SE)	Male (Mean±SE)	Female (Mean±SE)
I	Plasma Triglycerides (mg/d1)	A	$116.99^{a}\pm4.19$	$106.97^{a}\pm4.38$	$128.47^{a}\pm4.70$	$118.33^{a}\pm4.36$	$137.82^{a}\pm4.34$	$121.86^{a}\pm4.32$
		B	$105.77^{ab}\pm3.20$	$93.75^{ab}\pm3.49$	$119.79^{ab}\pm4.07$	$101.67^{b}\pm4.36$	$98.96^{b}\pm4.95$	$103.83^{b}\pm3.72$
		C	$95.35^{b}\pm3.95$	$86.14^{b}\pm5.45$	$107.64^{b}\pm4.70$	$91.67^{b}\pm5.48$	$92.55^{b}\pm4.87$	$90.95^{b}\pm5.84$
II	Plasma Cholesterol (mg/dl)	A	$104.00^{a}\pm5.21$	135.55 ± 5.81	151.11 ± 9.04	$150.00^{a}\pm5.58$	$160.00^{a}\pm4.44$	$153.33^{a}\pm5.21$
		B	$133.33^{ab}\pm4.44$	126.67 ± 5.21	137.94 ± 9.85	$135.72^{ab}\pm5.58$	$140.00^{b}\pm5.21$	$131.11^{b}\pm5.81$
		C	$120.00^{b}\pm4.44$	115.64 ± 4.12	120.10 ± 6.67	$121.43^{b}\pm5.58$	$122.22^{c}\pm5.81$	$126.67^{b}\pm5.21$
III	IDL Cholesterol (mg/dl)	A	58.02 ± 3.31	54.42 ± 2.67	52.70 ± 3.86	61.39 ± 3.66	56.43 ± 3.21	70.39 ± 3.22
		B	57.63 ± 5.31	49.31 ± 2.67	48.27 ± 3.86	61.16 ± 3.06	55.36 ± 3.65	68.17 ± 3.21
		C	57.50 ± 3.31	49.68 ± 2.69	47.81 ± 4.36	58.52 ± 3.12	53.13 ± 3.55	66.41 ± 3.31
IV	HDL Cholesterol (mg/dl)	A	29.33 ± 3.13	33.00 ± 3.53	40.60 ± 2.89	36.55 ± 2.01	41.56 ± 2.43	28.11 ± 1.92
		B	28.11 ± 2.89	32.33 ± 3.11	37.98 ± 3.15	35.81 ± 2.89	39.11 ± 2.53	28.22 ± 2.41
		C	23.67 ± 2.65	30.11 ± 3.13	36.43 ± 2.89	32.66 ± 2.01	37.89 ± 2.43	29.33 ± 2.40
V	Total serum protein (g/dl)	A	$2.43o^{c}\pm0.08$	$2.34^{c}\pm0.08$	$2.65^{c}\pm0.10$	$2.43^{b}\pm0.10$	$2.98^{b}\pm0.10$	$2.67^{b}\pm0.13$
		B	$2.82^{b}\pm0.08$	$2.79^{b}\pm0.09$	$3.00^{a}\pm0.13$	$2.94^{a}\pm0.13$	$3.32^{a}\pm0.10$	$3.04^{ab}\pm0.13$
		C	$3.27^{a}\pm0.11$	$3.23^{a}\pm0.07$	$3.06^{a}\pm0.08$	$3.03^{a}\pm0.10$	$3.41^{a}\pm0.07$	$3.22^{a}\pm0.13$

Within each biochemical parameter represented in the above table means bearing differ superscripts differ significantly ($P<0.05$)

Feed efficiency was improved by isoproterenol treatment and the effect was more in males (Table 1). Hargis *et al.* (1988) showed that isoproterenol improved feed efficiency in male broilers on dietary administration. The improved feed efficiency in this study agreed with this finding. The predominance of the drug effect in male broilers can be attributed to the fact that male broilers had more abdominal fat when compared to females upto 46 days of age (Hargis and Creger, 1980). Hence a lipolytic drug will produce better effect in males than females.

The effect of isoproteremol on serum biochemical constituents is presented in Table 2. It produced a significant reduction in plasma triglycerides uniformly at 0.30 mg/kg in all the three weeks of observation. Plasma cholesterol was found decreased at 6th week in both sexes. The drug treatment has not produced any change in LDL and HDL cholesterol level in both sexes. Both 0.15 mg/kg and 0.30 mg/kg of isoproterenol has produced a uniform increase in total serum protein. Total body protein (carcass protein) was significantly increased by isoproterenol treatment at 0.30 mg/kg in both sexes (Table 3).

Table 3 Effect of Isoproterenol on total body protein (Carcass Protein) and total body lipid (Carcass fat) in broilers

Treatment	Carcass Protein (%)		Carcass Fat (%)	
	Male (Mean±SE)	Female (Mean±SE)	Male (Mean±SE)	Female (Mean±SE)
Control	20.83^{b}±0.46	20.55^{b}±0.42	9.86^{a}±0.15	9.51^{a}±0.17
Isoproterenol 0.15 mg/kg	21.39^{b}±0.26	22.32^{a}±0.30	8.24^{b}±0.10	8.20^{b}±0.04
Isoproterenol 0.30 mg/kg	23.15^{a}±0.43	23.06^{a}±0.30	7.99^{b}±0.05	7.93^{b}±0.03

Mean bearing different superscripts differ significantly ($P<0.05$)

Potter and Ellis (1975) found that isoproterenol stimulated the secretion of insulin. Morgan *et al.* (1971) and Sender and Garlick (1973) have reported that increased secretion of insulin is capable of increasing the rate of protein synthesis. Grant *et al.* (1990) established that isoproterenol enhanced the proliferative activity of the chick satellite cells in vitro. Beerman *et al.* (1985) stated that beta receptor agonists reduced protein degradation in muscle and stimulated the fractional protein synthesis rate resulting in diverting nutrient flow away from fat deposition towards muscle accretion. Perkins *et al.* (1985) reported that growth hormone or insulin release may mediate some of these effects of beta agonists.

Total body lipid (carcass fat) was reduced significantly by both the doses of isoproterenol (Table 3). Substituted catecholamine was reported to increase leaness and reduce fat in various species like sheep (Baker *et al.*, 1984), Cattle (Ricks *et*

al., 1984), pigs (Jones *et al.*, 1985 and Dalrymple *et al.*, 1984) and male broilers (Hargis *et al.*, 1988). The results of this study are in agreement with the findings of the above workers with regard to reduction in total body lipid (carcass fat).

Summary

Isoproterenol increased the cumulative weight gain and improved feed efficiency. It also lowered plasma triglycerides preferbly at 0.30 mg/kg dose. It reduced plasma cholesterol. The drug significantly increased the total serum protein. Isoproterenol also increased total body protein (carcass protein) percentage preferably at 0.30 mg/kg and both 0.15 mg/kg and 0.30 mg/kg consistently reduced carcass fat.

Acknowledgement

The authors thank the Dean, Madras Veterinary College for the facilities provided to carry out this work.

References

A.O.A.C (1980). Association of official analytical chemists, Official methods of analysis, 13th Ed. Washington. D.C.

Baker, P.K., Dalrymple, R.H., Ingle, D.L. and Ricks, C.A. (1984). Use of a Beta adrenergic agonist to alter muscle and fat deposition in lambs. *J. Anim. Sci.* **59:** 1206-1261

Beerman, D.H., Fishell, V.K., Hogue, D.E., Ricks, C.A. and Dalrymple, R.H. (1985). Effect of repartioning agent cimaterol (C1.263780) and fish meal on skeletal muscle and fat accretion in lambs. *J. Anim. Sci.* **61** (Supplement 1) **254** (abstract)

Bucolo, G. and David, H. (1978). Quantitative determination of serum triglycerides by use of enzymes. Clin. Chem. **19**: 476

Dalrymple, R.H., Baker, P.K., Gingher, P.E., Ingle, D.L. Pensack, J.H. and Ricks, C.A. (1984). A repartioning agent to improve performance and carcass composition of broilers. Poultry Sci. **63:** 2376-2383

Friedewald, W.T., Levy, R.I. and Frederickson, D.S. (1972). Estimation of the concentration of low density lipoprotein cholesterol in plasma without use of the preparative ultracentrifuge. *Clin. Chem.*, **18:** 499-502

Grant, A.L., Helferich, W.G., Merkel, R.A. and Berger, W.G. (1990). Effect of phenetholamines and propranolol on the proliferation of chick breast muscle satellite cells. *J. Anim. Sci.*, **60**: 652-658

Hargis, P.H. and Creger, C.R. (1980). Effects of varying dietary protein and energy levels on growth rate and body fat of broilers. Poultry Sci., **59**: 1499-1504

Hargis, P.S., Greene, S.F., Sandel, G.W., Guerra, C.M. Patterson, W. and Odom, T.W. (1988). Effect of dietary or in Ovo Isoproterenol administration on growth and fattening of broilers. Poultry Sci., **67:** Supplement 1: 95

Jones, R.W., Easter, R.A., Mekeith, F.K., Dalrymple, R.H., Maddlock, H.H. and Bochtel (1985). Effects of the beta-adrenergic agonist cimaterol on the growth and carcass characteristics of finishing swine. *J. Anim. Sci.*, **61**: 905-913.

Mallov, S. (1973). Effect of sympathomimetic drugs on protein synthesis in rat heart. *J. Pharmacol Exp. Ther.* **187**: 482-494

Morgan, H.E., Jefferson, L.S., Wolpert, E.B. and Rammels, R. (1971). Regulation of protein synthesis in the muscle. ii. Effect of amino acid levels and insulin on nutritional aggregation *J. Biol. Chem.* **246:** 2163-2170

Perkins, S.N., Evans, W.S., Thomer, M.O., Gibbs, D.M. and Cronin, M.K. (1985). Beta-adrenergic binding and secretory responses of the anterior pituitary. Endocrinology. **117**: 1818-1825

Potter, R.E. and Ellis, S. (1975). Isoproterenol and epinephrine induced changes in blood glucose and tissue glycogen levels in normal and diabetic rats - the influence of alteration in endogenous insulin levels and state of nourishment. *J. Pharmacol. Exp. Ther.* **193**: 576-584

Ricks, C.A., Dalrymple, R.H., Baker, P.K. and Ingle, D.I. (1984). Use of Beta -agonist to alter fat and muscle deposition in steers. *J. Anim. Sci.,* **59**: 1247-1255

Roe, J.H. and Byler, B.E. (1963). Serum lipase determination using a one hour period of hydroysis. Analyt. Chem. 6: 451 - 460 cited by Brobst. D. and Brester. J.E. In: serum lipase determination in the dog using a one hour test *J. Amer. Vet. Med. Assoc.*, **150**: 767

Sender, P.M. and Garlick, P.J. (1973). Symthesis rate of protein in the Langendorff perfused rat heart in the presence and absence or insulin and in the working heart. Biochem. J., **32:** 603-608

Snedecor, G.W. and Cochran, W.G. (1989). Statistical methods. 6th Ed., Iowa State Univ. Press Ames

Vorley, H., Gowenlock, A.M. and Bell, M. (1980). Practical clinical Biochemistry, 5th Ed. William Hinemann Medical books Ltd., London. pp 550-669