Archives of Razi Institute, Vol. 77, No. 1 (2022) 141-149

DOI: 10.22092/ARI.2021.354450.1638

Original Article

Correlation of Histamine Receptors and Adrenergic Receptor in Broilers Appetite

Daneshvar, M[1], Zendehdel, M[2 *], Vazir, B[1], Asghari, A[3]

1. Department of Basic Sciences, Faculty of Veterinary Medicine, Science and Research Branch, Islamic Azad University, Tehran, Iran
2. Department of Basic Sciences, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran
3. Department of Clinical Sciences and Technologies, Faculty of Veterinary Medicine, Science and Research Branch, Islamic Azad University, Tehran, Iran

Received 12 May 2021; Accepted 9 June 2021
Corresponding Author: zendedel@ut.ac.ir

Abstract

The current study was conducted to investigate the interaction between the central adrenergic and histaminergic systems and the broiler chick's feed intake. In the first experiment, the intracerebroventricular (ICV) injection of solutions was conducted which included 10 nmol of prazosin (an α_1-receptor antagonist), 300 nmol of histamine, co-injection of prazosin and histamine. Experiments two to five were conducted similarly the same as the first experiment, in which chickens were ICV injected with 13 nmol of yohimbine (an α_2-receptor antagonist), 24 nmol of metoprolol (a β_1 adrenergic receptor antagonist), 5 nmol of ICI 118,551 (a β_2 adrenergic receptor antagonist), and 20 nmol of SR 59230R (a β_3 adrenergic receptor antagonist). The injected solutions in the sixth experiment included 300 nmol of noradrenaline, 250 nmol of α-FMH (an alpha fluoromethyl histidine), noradrenaline, and α-FMH. Seventh to ninth experiments were similar to the sixth experiment, except that the chickens were ICV injected with 300 nmol of chlorpheniramine (a histamine H_1 receptors antagonist), 82 nmol of famotidine (a histamine H_2 receptors antagonist), and 300 nmol of thioperamide (a histamine H_3 receptors antagonist), rather than α-FMH. Afterward, the cumulative food intake was measured 120 min after injection. Based on the obtained results, both histamine ICV injection and noradrenaline injection reduced food intake (P<0.05). Moreover, co-injection of histamine and ICI 118,551 (P<0.05), and co-injection of noradrenaline and Chlorpheniramine reduced food intake (P<0.05). In addition, noradrenaline and Thioperamide co-injection improved hypophagic effect of noradrenaline in neonatal chicken (P<0.05). These findings suggested the effect of interconnection between adrenergic and histaminergic systems, which may be mediated by H_1 and H_3 histaminergic and β_2 adrenergic receptors, on the regulation of food intake in the neonatal broiler chicken.

Keywords: Adrenergic, Broiler chicken, Food intake, Histamine

1. Introduction

Regulation of appetite is among the complex aspects of animals' life and is modulated through both the central nervous system (CNS) and peripheral nervous system (PNS). In the brain, appetite is regulated by diverse neurotransmitters in hypothalamic areas, including the arcuate nucleus, nucleus tractus solitarius, and amygdala (1). Noradrenalin is a catecholamine neurotransmitter in the CNS. The norepinephrine (NE) has two major receptors, including α adrenergic (including α_1 and α_2) and β adrenergic (including β_1, β_2, and β_3). Based on the evidence, ICV injection of the norepinephrine or clonidine (as an α_2-receptor agonist) increases food intake, which yohimbine (as an α_2 receptor antagonist) inhibited food intake (2). ICV injection of clonidine raised the broilers' food intake as

well (3). However, ICV injection of salbutamol (β_2 adrenergic receptor agonist) reduced the rats' cumulative food intake (4), and ICV injection of isoproterenol (β_1 and β_2 adrenergic receptor agonist) reduced chicken's food and water intake, respectively (5).

Moreover, the feeding behavior is not mediated by a single neuropeptide. Various neurotransmitters interact through a widely distributed neural network for the regulation of food intake in both animals and humans (6). Histaminergic (HAergic) neurons are among the most impressive neurons in the brain and seem to play a vital role in controlling food intake. Central HAergic neurons were found in the tuberomammillary nucleus with axon projects branched to various brain areas (7). Brain histamine is of high importance in determining feeding behavior. Consequently, histamine administration through the ICV route reduced food intake, while food intake was elevated under the influence of chlorpheniramine, as an antagonist of H_1 receptor, and α-FMH, as a selective inhibitor of the histamine-synthesizing enzyme histidine decarboxylase (8).

Previously, interaction between central HAergic and adrenergic neurons on physiological function has been reported. The majority of the H_1 receptor antagonist antipsychotics and antidepressants considerably changed the sleep-wake cycle through adrenergic receptors. Moreover, central H_2 and α_2 adrenergic receptors are involved in crocetin-induced antinociception (9). Investigations have shown that the antinociceptive effect of intra-peritoneal administration of xylazine (α_2 adrenergic receptor agonist) is antagonized by yohimbine but not by naloxone (an opioid receptor antagonist). Microinjection of ranitidine (H_2 receptor blocker) prevented histamine-induced anti-nociception in orofacial formalin pain (10). The adrenal medulla H_1 receptor elicits the release of adrenaline and noradrenaline. Histamine can stimulate phosphorylation of the tyrosine hydroxylase enzyme by intracellular calcium release from chromaffin cells of the adrenal gland (11).

The noradrenergic (NAergic) and HAergic systems play a vital role in food intake control in birds and mammals. In a similar report, Mirnaghizadeh, Zendehdel (12) reported that oxytocin-induced hypophagia is possibly mediated in broiler chickens through H_1 and H_3 histaminergic and β_2 NAergic receptors. ICV co-injection of histamine and NA results in systemic and intranuclear elevation of oxytocin release in rats (13). Existing literature reported no interaction between these systems in the broilers' feeding behaviors. Therefore, the present study aimed to investigate the potential interaction of central histaminergic and adrenergic systems in food intake regulation in broiler chickens.

2. Materials and Methods

2.1. Animals

The current study was performed on 396 one-day-old broiler chickens (ROSS 308) supplied by a local hatchery (Morghak Co., Iran). They were kept in stabilizing electrically-heated batteries at the temperature of 32±1ºC, relative humidity of 40%-50%, and lighting/dark period of 23:1 (14). The subjects were taken care of at the mentioned conditions for two days as flocks, and then they were randomly allocated and transferred to the individual cages. Moreover, the broiler chickens were provided with a commercial diet containing 2,850 kcal/kg metabolizable energy and 21% crude protein during the study (Chineh Co., Iran) (Table 1). The birds had free access to fresh water and food. The subjects were food-deprived for 3 h (FD_3) before injections; however, they were allowed to drink water. The five-day-old birds underwent ICV injections.

2.2. Experimental Medications

The administered medications in the present study included histamine prazosin (an α_1 receptor antagonist), metoprolol (a β_1 adrenergic receptor antagonist), yohimbine (an α_2 receptor antagonist), SR 59230R (a β_3 adrenergic receptor antagonist), ICI 118,551 (a β_2 adrenergic receptor antagonist), chlorpheniramine (an H_2 receptor antagonist), noradrenaline, thioperamide (an H_3 receptor antagonist), famotidine (an H_2 receptor

antagonist), α-FMH (an alpha fluoromethyl histidine), and Evans blue. All the medications were supplied from Sigma-Aldrich (USA) and Tocris Co. (UK), which were then dissolved in an absolute solution of dimethyl sulfoxide (DMSO). Afterward, the medicines were diluted using 0.85% saline, which contained Evans Blue at a 1:250 ratio (0.4% DMSO). No cytotoxic effect was found for DMSO at this ratio. The DMSO/saline mixture containing Evans blue was utilized for the control group.

Table 1. Ingredient and nutrient analysis of experimental diet

Ingredient	(%)	Nutrient analysis	
Corn	52.85	ME, kcal/g	2850
Soybean meal, 48% CP	31.57	Crude protein (%)	21
Wheat	5	Linoleic acid (%)	1.69
Gluten meal, 61% CP	2.50	Crude fiber (%)	3.55
Wheat bran	2.47	Calcium (%)	1
Di-calcium phosphate	1.92	Available phosphorus (%)	0. 5
Oyster shell	1.23	Sodium (%)	0.15
Soybean oil	1.00	Potassium (%)	0.96
Mineral premix	0.25	Chlorine (%)	0.17
Vitamin premix	0.25	Choline (%)	1.30
Sodium bicarbonate	0.21	Arginine (%)	1.14
Sodium chloride	0.20	Isoleucine (%)	0.73
Acidifier	0.15	Lysine (%)	1.21
DL-Methionine	0.10	Methionine (%)	0.49
Toxin binder	0.10	Methionine+cystine (%)	0.83
L-Lysine HCl	0.05	Threonine (%)	0.70
Vitamin D_3	0.1	Tryptophan (%)	0.20
Multi enzyme	0.05	Valine (%)	0.78

ME: metabolizable energy, CP: crude protein (per kg of diet), the mineral supplement containing 35.2 g manganese from MnSO4·H2O; 22 g iron from FeSO4·H2O; 35.2 g zinc from ZnO; 4.4 g copper from CuSO4·5H2O; 0.68 g iodine from ethylene diamine dihydroiodide; 0.12 g selenium from Na2SeO3. The vitamin supplement containing 1.188 g of retinyl acetate, 0.033 g of dl-α-tocopheryl acetate, 8.84 g of tocopherol, 1.32 g of menadione, 0.88 g of thiamine, 2.64 g of riboflavin, 13.2 g of nicotinic acid, 4.4 g of pantothenic acid, 1.76 g of pyridoxine, 0.022 g of biotin, 0.36 g *of folic acid, 1500 mg of* choline chloride.

2.3. ICV Injections

The subjects were randomly assigned to nine experimental groups, including four sub-groups (n=44). Initially, the birds were weighed and accordingly allocated to the test groups so that the mean body weight of different treatment groups was similar. The ICV injections were performed once for each group, without anesthesia, using a microsyringe (Hamilton, Switzerland) following the techniques adopted by Davis, Masuoka (15). In summary, the head of the chicken was held using an acrylic device and a bill holder at an angle of 45º. Calvarium was parallel to table surface, according to van Tienhoven and Juhász (16). Subsequently, an orifice was made in a plate over the skull surrounding the right lateral ventricle, which was then used to insert the microsyringe. The needle tip perforated 4 mm under the skull skin and the 10 µL of the solutions were injected in all groups (17). Moreover, animals in the control group were injected with the control solution (10 µL). It should be noted that the mentioned method did not cause physiological stress for the newly hatched chickens (17). Decapitation was carried out using ketamine overdose to ascertain injection accuracy at the end of the experiments. Injection site accuracy in the ventricle was confirmed by the presence of Evans blue and slicing the frozen brain tissues. All birds in the

intervention groups received injections. However, only the data from 11 birds in each group were analyzed in which dye was present in the lateral ventricle. All testing procedures were carried out from 8 am to 3 pm.

2.4. Feeding Experiments

In the first experiment, the control solution, including 10 nmol of prazosin (an α_1-receptor antagonist), 300 nmol of histamine, as well as prazosin and histamine were ICV injected into the FD_3 birds. Experiments two to five were conducted similar to the first experiment, in which FD_3 birds were ICV injected with 13 nmol of yohimbine (an α_2-receptor antagonist), 24 nmol of metoprolol (a β_1 adrenergic receptor antagonist), 5 nmol of ICI 118,551 (a β_2 adrenergic receptor antagonist), and 20 nmol of SR 59230R (a β_3 adrenergic receptor antagonist). In the sixth experiment, control solution, including 300 nmol of noradrenaline, 250 nmol of α-FMH, and noradrenaline and α-FMH were injected into the chickens. Seventh to ninth experiments were similar to the sixth experiment, except that the FD_3 birds were ICV injected with 300 nmol of chlorpheniramine (a histamine H_1 receptors antagonist), 82 nmol of famotidine (a histamine H_2 receptors antagonist), and 300 nmol of thioperamide (a histamine H_3 receptors antagonist) rather than α-FMH (Table 2). Following the completion of injections, the birds were fed, and cumulative food intake was quantified 30 min, 60 min, and 120 min following the injection. The food consumption was recorded as percent of body weight (g/100g BW) to overcome the body weight's effect on food intake. (g/100g BW) to overcome the body weight's effect on food intake.

Table 2. Treatments procedure in nine experiments

Exp. 1	**ICV Injection**
Treatment groups	
A	CS*
B	Prazosin (10 nmol)
C	Histamine (300 nmol)
D	Prazosin + Histamine
Exp. 2	**ICV Injection**
Treatment groups	
A	CS *
B	Yohimbine (13 nmol)
C	Histamine (300 nmol)
D	Yohimbine + histamine
Exp. 3	**ICV Injection**
Treatment groups	
A	CS *
B	Metoprolol (24 nmol)
C	Histamine (300 nmol)
D	Metoprolol + histamine
Exp. 4	**ICV Injection**
Treatment groups	
A	CS *
B	ICI 118,551 (5 nmol)
C	Histamine (300 nmol)
D	ICI 118,551 + histamine
Exp. 5	**ICV Injection**
Treatment groups	
A	CS *
B	SR 59230R (20 nmol)
C	Histamine (300 nmol)
D	SR 59230R + histamine
Exp. 6	**ICV Injection**
Treatment groups	
A	CS *
B	α-FMH (250 nmol)
C	NA (300 nmol)
D	α-FMH + NA
Exp. 7	**ICV Injection**
Treatment groups	
A	CS *
B	Chlorpheniramine (300 nmol)
C	NA (300 nmol)
D	Chlorpheniramine + NA
Exp. 8	**ICV Injection**
Treatment groups	
A	CS *
B	Famotidine (82 nmol)
C	NA (300 nmol)
D	Famotidine + NA
Exp. 9	**ICV Injection**
Treatment groups	
A	CS *
B	Thioperamide (300 nmol)
C	NA (300 nmol)
D	Thioperamide + NA

CS: control solution, prazosin: an α_1 receptor antagonist, metoprolol: β_1 adrenergic receptor antagonist, yohimbine: α_2 receptor antagonist, SR 59230R: β_3 adrenergic receptor antagonist, ICI 118,551: β_2 adrenergic receptor antagonist, chlorpheniramine: H_2 receptor antagonist, NA: noradrenaline, thioperamide: H_3 receptor antagonist, famotidine: H_2 receptor antagonist, α-FMH: alpha fluoromethyl histidine.

2.5. Statistical Analysis

The current study included nine experimental groups. Each test group included four subgroups (I-

IV). Only one injection was performed in each group. Cumulative food intake was presented as g/100g BW for the analysis of each intervention group using two-way repeated-measures analysis of variance (ANOVA). Data were analyzed using SPSS software (Version 16) (IBM, Chicago, Il., USA). The Tukey test (P<0.05) was used to compare means, and the descriptive statistics were reported as mean±SEM.

3. Results

In the first experiment, hypophagia was observed after ICV injection of histamine (300 nmol) (P<0.05). However, prazosin (10 nmol) injection did not affect the cumulative food intake (P>0.05). Moreover, the co-injection of prazosin and histamine had no impact on hypophagia due to histamine in chickens (P>0.05) (Figure 1).

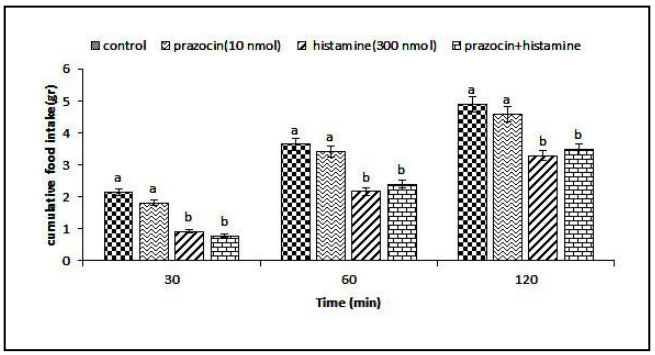

Figure 1. Effect of ICV injection of prazosin (10 nmol), histamine (300 nmol), and their combination on the percent of body weight cumulative food intake in neonatal meat-type chickens (n=44). prazosin: α_1 receptor antagonist. Data are expressed as mean±SEM. Different letters (a and b) indicate significant differences between treatments (P<0.05).

In the second experiment, hypophagia was observed after ICV injection of histamine (300 nmol) (P<0.05). However, yohimbine (13 nmol) did not affect the cumulative food intake (P>0.05) in chickens. Co-injection of yohimbine and histamine had no impact on hypophagia due to histamine in chickens (P>0.05) (Figure 2).

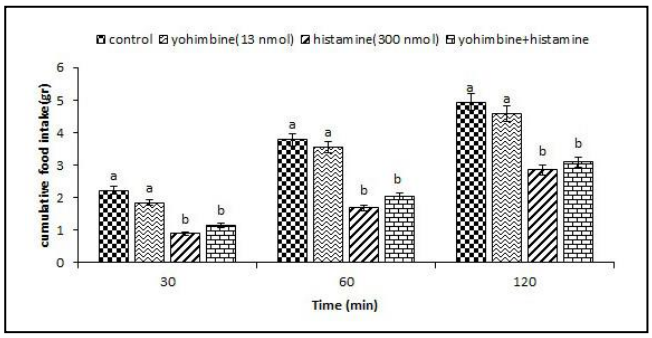

Figure 2. Effect of ICV injection of yohimbine (13 nmol), histamine (300 nmol), and their combination on the percent of body weight and cumulative food intake in neonatal meat-type chickens (n=44). Yohimbine: α_2 receptor antagonist. Data are expressed as mean±SEM. Different letters (a and b) indicate significant differences between treatments (P<0.05).

In the third experiment, ICV injection of histamine (300 nmol) reduced food intake, compared to the control group (P<0.05). Metoprolol (24 nmol) did not affect the cumulative food intake (P>0.05), and co-injection of metoprolol and histamine had no impact on hypophagia due to histamine in chickens (P>0.05) (Figure 3).

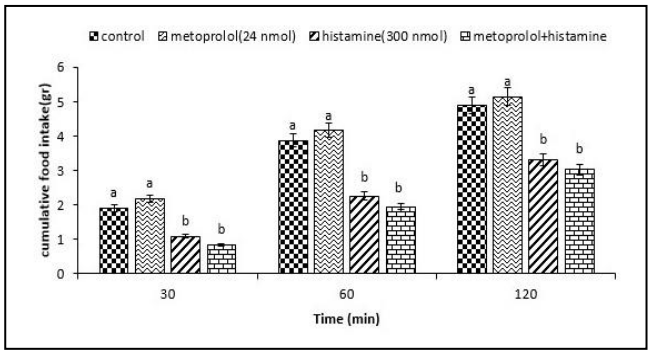

Figure 3. Effect of ICV injection of metoprolol (24 nmol), histamine (300 nmol), and their combination on the percent of body weight and cumulative food intake in neonatal meat-type chickens (n=44). Metoprolol: β_1 adrenergic receptor antagonist. Data are expressed as mean±SEM. Different letters (a and b) indicate significant differences between treatments (P<0.05).

In the fourth experiment, ICV injection of histamine (300 nmol) reduced food intake in comparison with the control group (P<0.05). However, ICI 118,551 (5 nmol) did not significantly affect the cumulative food intake (P>0.05). Co-injection of the ICI 118,551 and histamine significantly reduced histamine-induced hypophagia in comparison with the control group (P<0.05) (Figure 4).

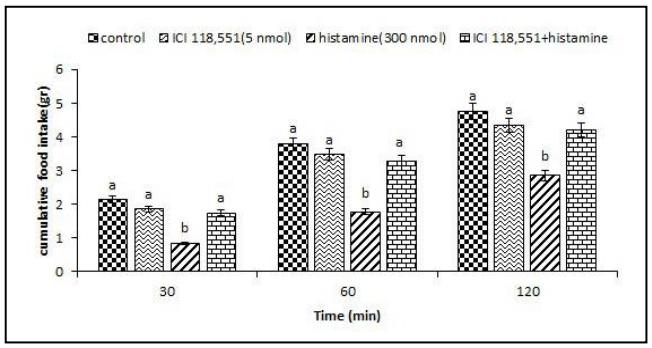

Figure 4. Effect of ICV injection of ICI 118,551 (5 nmol), histamine (300 nmol), and their combination on the percent of body weight cumulative food intake in neonatal meat-type chickens (n=44). ICI 118,551: β_2 adrenergic receptor antagonist. Data are expressed as mean±SEM. Different letters (a, b, and c) indicate significant differences between treatments (P<0.05).

In the fifth experiment, hypophagia was observed following ICV injection of histamine (300 nmol) (P<0.05). Cumulative food intake did not change after the injection of SR 59230R (20 nmol) (P>0.05). Co-injection of SR 59230R and histamine exerted no impact on hypophagia due to histamine in chickens (P>0.05) (Figure 5).

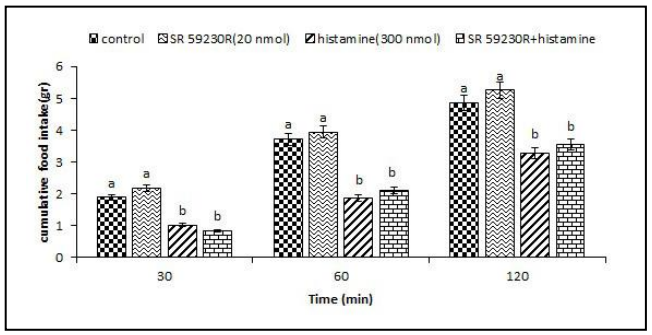

Figure 5. Effect of ICV injection of SR 59230R (20 nmol), histamine (300 nmol), and their combination on the percent of body weight and cumulative food intake in neonatal meat-type chickens (n=44). SR 59230R: β_3 adrenergic receptor antagonist. Data are expressed as mean±SEM. Different letters (a and b) indicate significant differences between treatments (P<0.05).

In the sixth experiment, ICV injection of NA (300 nmol) reduced food intake in comparison with the control group (P<0.05). However, α-FMH (250 nmol) did not significantly affect the cumulative food intake (P>0.05). Co-injecting of the α-FMH and NA reduced NA-induced hypophagia, compared to the control group (P<0.05) (Figure 6).

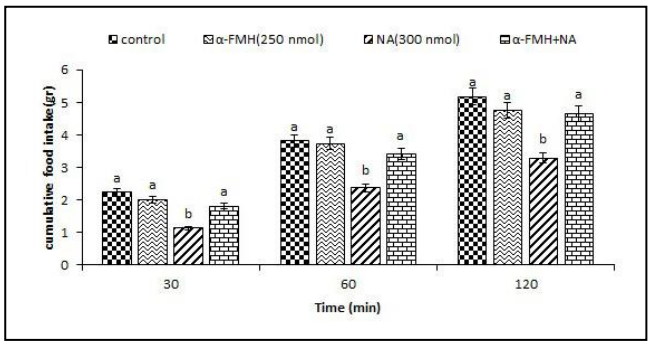

Figure 6. Effect of ICV injection of α-FMH (250 nmol), NA (300 nmol), and their combination on cumulative food intake in neonatal meat-type chickens (n=44). α-FMH: alpha fluoromethyl histidine (inhibitor of histidine decarboxylase), NA: noradrenaline. Data are expressed as mean±SEM. Different letters (a and b) indicate significant differences between treatments (P<0.05).

In the seventh experiment, hypophagia was observed following ICV injection of NA (300 nmol) (P<0.05). However, Chlorpheniramine (300 nmol) did not significantly affect the cumulative food intake (P>0.05). Co-injection of the chlorpheniramine and NA reduced NA-induced hypophagia, compared to the control group (P<0.05) (Figure 7).

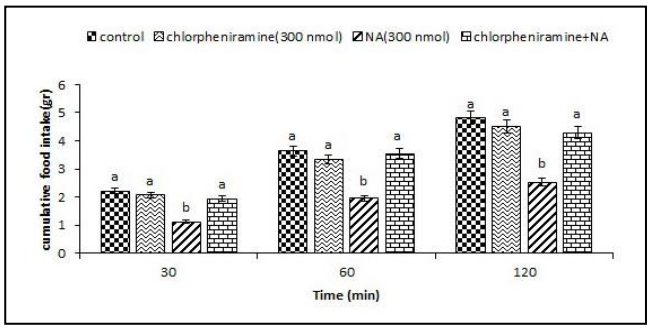

Figure 7. Effect of ICV injection of chlorpheniramine (300 nmol), NA (300 nmol), and their combination on cumulative food intake in neonatal meat-type chickens (n=44). Chlorpheniramine: histamine H1 receptors antagonist, NA: noradrenaline. Data are expressed as mean±SEM. Different letters (a and b) indicate significant differences between treatments (P<0.05).

In the eighth experiment, ICV injection of NA (300 nmol) reduced food intake in comparison with the control group (P<0.05). Famotidine (82 nmol) did not significantly affect the cumulative food intake (P>0.05). Co-injection of NA and famotidine did not significantly affect hypophagia due to the NA in chickens (P>0.05) (Figure 8).

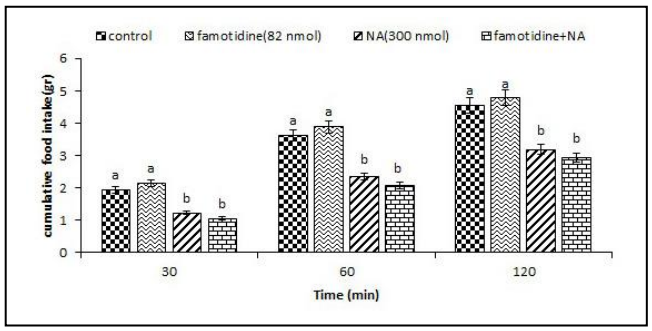

Figure 8. Effect of ICV injection of famotidine (82 nmol), NA (300 nmol), and their combination on cumulative food intake in neonatal meat-type chickens (n=44). Famotidine: histamine H2 receptors antagonist, NA: noradrenaline. Data are expressed as mean±SEM. Different letters (a and b) indicate significant differences between treatments (P<0.05).

In the ninth experiment, ICV injection of NA (300 nmol) reduced food intake, in comparison with the control group (P<0.05). Thioperamide (300 nmol) did not significantly affect the cumulative food intake (P>0.05). ICV injection of the thioperamide and NA intensified NA-induced hypophagia, in comparison with the control group (P<0.05) (Figure 9).

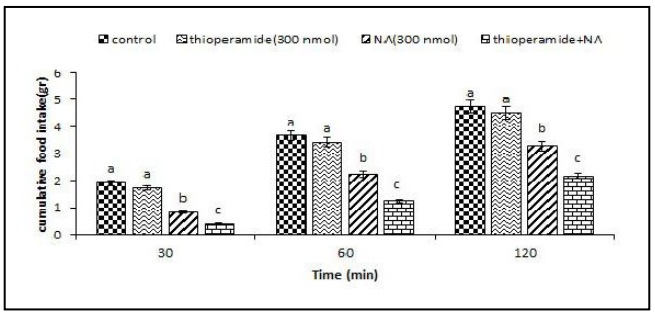

Figure 9. Effect of ICV injection of thioperamide (300 nmol), NA (300 nmol), and their combination on cumulative food intake in neonatal meat-type chickens (n=44). Thioperamide: histamine H3 receptors antagonist, NA: noradrenaline. Data are expressed as mean±SEM. Different letters (a, b, and c) indicate significant differences between treatments (P<0.05).

4. Discussion

To the best of the authors' knowledge, the present study was the first report regarding the interconnection between HAergic and adrenergic systems in the regulation of food intake in broiler chickens. Based on the obtained results, ICV injection of histamine (300 nmol) reduced food intake. H_1 receptors are considered hypophagic receptors in broiler chickens and rats (18). In broilers, the anorexic effects were reported for the H_2 receptors, and thioperamide reduced cumulative food intake in the broilers (18). Although the H_1 receptors are used to mediate the effects of histamine in poultry (19), controversial debates exist regarding the role of H_3 receptors. It was reported that ICV injection of thioperamide (300 and 600 nmol) reduced the food intake in the deprived-food broilers (18). Limited information is available regarding H_4 receptors in the poultry brain (19). ICV injection of thioperamide did not significantly affect feeding behavior in the food-deprived or non-deprived rats in the lighting period (20); however, it reduced their appetite in the dark period in which the central levels of histamine was low. This indicated the impact of histamine on the low activity of the histaminergic system by H3 presynaptic autoreceptor (20). The H_3 receptors blockade reduced food intake among rats, while H_1 receptor antagonist injection attenuated H_3 antagonist effects among rats (20).

Results of this study suggested that ICV injection of NA (300 nmol) reduced food intake. Baghbanzadeh, Hamidiya (5) reported that ICV injection of β adrenergic receptor antagonists diminished food and water intake in broilers. Moreover, ICV injection of 5 nmol of ICI 118,551 (a β_2 adrenergic receptor antagonist) or 20 nmol of SR 59230R (a β_3 adrenergic receptor antagonist) improved broilers' cumulative food intake (3).

Based on the findings of the present study, co-injection of histamine and a β_2 adrenergic receptor antagonist and the co-injection of the NA and histamine H_1 receptor antagonist decreased food intake. Moreover, co-injection of NA and histamine H_3 receptor antagonists intensified the hypophagic effects of NA in neonatal chickens. These findings demonstrated that structurally the H_1 receptor was much similar to β_1- and β_2-adrenoceptors as well as the dopamine D_3 receptor (21), while it was considerably different from the chemokine receptor $CXCR_4$ and the adenosine A_2A receptor (21). Activation of brain

HAergic and NAergic neurons induces the release of neurohypophysial hormones, including oxytocin and arginine vasopressin that are involved in the are involved in the hormone responses by physiological stimuli, including suckling and dehydration (22). Activation of H_1 receptor leads to excitation in the majority of brain sites (including hypothalamus, brainstem, thalamus, striatum, cortex, amygdala) via Gq protein as well as direct blockade of a potassium leak conductance or inositol trisphosphate (IP_3), diacylglycerol (DAG), and phospholipase C mediation (22). The histaminergic neurons in TMN are projected to the rest of brain areas in addition to the rest of hypothalamic sites, such as SON (Supra optic nucleus) and PVN (Paraventricular nucleus). Moreover, noradrenergic neurons originating from the brain stem are spread across the PVN and SON. HAergic, adrenergic, and NAergic fibers contact the oxytocinergic neurons in SON and PVN in the hypothalamus (12). ICV injection of NE into the PVN improves food intake in the domestic fowls (23). ICV injection of the clonidine (an α_2 receptor agonist) or NE increases food intake, which is inhibited by yohimbine (an α_2 receptor antagonist), not by prazosin (an α_1 receptor antagonist). ICV injection of clonidine improved broilers' food intake (4), while ICV administration of NE did not affect the feeding behavior in layers (24). ICV injection of non-selective isoproterenol (a β adrenergic receptor agonist) reduced food intake in rats, while the anorexigenic effect was observed by β_3 adrenergic receptor agonist.

Several studies have been conducted on the central regulation of food intake in rat models. It is known that the central regulation of food intake is not similar in birds and mammals (3). Therefore, it is rational to investigate the regulatory mechanisms of food intake in birds. It was not possible to compare the results of the present study with other researches due to limited information on the interconnection of HAergic and ADergic receptors and the food intake processes.In conclusion, the results of the present study suggest that the interconnection of the adrenergic and histaminergic systems is mediated through β_2 adrenergic, H_1, and H_3 histaminergic receptors on food intake in broiler chicken.

Authors' Contribution

Study concept and design: M. Z.
Acquisition of data: M. D.
Analysis and interpretation of data: B. V.
Drafting of the manuscript: M. D.
Critical revision of the manuscript for important intellectual content: M. Z.
Statistical analysis: A. A.
Administrative, technical, and material support: M. Z.

Ethics

All experimental procedures were approved by the Faculty of Veterinary Medicine, Islamic Azad University, Science and Research Branch, Tehran, Iran.

Conflict of Interest

The authors declare that they have no conflict of interest.

Grant Support

This study was supported by Science and Research Branch, Islamic Azad University, Tehran, Iran.

Acknowledgment

The authors would like to express their sincere regards to the authorities and staff in the central laboratory (Dr. Rastegar Lab) in the Veterinary Medicine Faculty, University of Tehran, Tehran, Iran, for their cooperation. This study was performed as a part of the first author's Ph.D. thesis.

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