

EFFECT OF INTRAPERITONEAL ADMINISTRATION OF AMINO ACIDS ON THE
FOOD INTAKE OF CHICKENS IN THE FIRST MONTH AFTER HATCHING

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Abstract

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Food intake of broilers aged 1 to 30 days was measured after intraperitoneal administrations of single doses of a commercial solution of amino acids (AA) (Nutramin Neo 8 % Spofa). The birds were allotted to 8 groups of 20 and had free access to commercial diets and to drinking water. Four groups were AA-injected (1 g. \cdot kg⁻¹) at 2, 5, 12 and 20 d of age, the remaining 4 groups at 3, 9 and 27 d invariably between 6.30 a 7 h. The groups not treated on the respective day served as controls. The treatment on d 2 was repeated in another batch of 160 birds and the results were pooled. The food intake of all groups was measured at 1-h intervals from 7 to 19 h and expressed also for the intervals 7-14 h, 14-19 h, 19-7 h and per 24 h.

Amino acid administration did not affect food intake in birds aged 2 d, it depressed food intake of chickens 3 d of age 1 h after the AA load as against controls. In birds 5 to 27 d of age the food intake of experimental groups was significantly decreased, compared with controls at all the intervals under study but especially between the 2nd and 12th hour after the AA load. Administration of AA elicited satiety with typical behavioural pattern. It is concluded that parenterally administered AA do operate as an aminostatic component in food intake regulation, that this component apparently begins to come into play from day 3 after hatching, and that the response to AA administration varies during the early posthatching period.

Age, chicken broilers, amino acids, food intake, depression.

Interactions between amino acid (AA) content of diets, AA blood plasma concentration, food intake and growth have repeatedly been

investigated also in poultry, e.g. after feeding diets containing either an AA surplus or deficient in AA (O'Mello and Lewis 1970 abc, 1971; Featherston 1976, 1979; Marks 1979; Carew et al. 1983; Penz et al. 1984), and after administration of individual AA into their digestive tracts (Lacy et al. 1982).

Complete starvation of newly hatched chickens resulted in a decrease of their plasma AA concentration to half of the initial values from day 1 until day 5 (Baranyiová and Pleskač 1976). In chickens of meat and layer types fed in two 1-h periods per day from day 1 till day 60 after hatching, their blood plasma concentration of proteins and total free AA was statistically significantly lower than in ad libitum fed controls at each of the samplings performed at 10-d intervals (Massalema 1975). Concentrations of the individual AA were also affected by the two feeding regimes. In an experiment, designed in the same way, blood plasma concentration of tryptophan in chickens with restricted access to food was significantly lower than that of controls fed ad libitum during the 60-day experiment (Holub et al. 1981; Baranyiová et al. 1982 ab).

Decreased protein concentration in a layer diet was compensated for by an increased consumption of the deficient diet (Cherry et al. 1984). In turkeys, feeding a diet supplemented with 0.5 % tryptophan for a period of 17 to 26 days or force-feeding of a single dose of 0.05 mol of L-tryptophan caused a significant increase of their hypothalamic serotonin concentration (Lee and Britton 1982).

To our knowledge, no data are available on the response of newly hatched chickens to an increased concentration of AA in their internal environment. To intraperitoneal administration of glucose, for example, they begin to respond by decreased food intake as early as the 2nd day after hatching (Baranyiová and Holub 1977). Our experiment was designed to study the food intake in response to administration of amino acids in newly hatched chickens.

Materials and Methods

A total of 160 Hybro broilers were allotted to 8 groups of 20 birds. They were reared in wire-floored batteries with heated brooding areas (starting at 35°C in the first week and continuing at gradually lower temperatures down to 26°C), and had free access to commercial starter BR I and grower BR II and to drinking water. Relative humidity in the animal room was about 60 %.

The birds were weighed daily between 6 and 7 a.m. during the maintenance. To measure their food intake, filled and preweighed food troughs were installed at 7 h, reweighed and refilled daily at 14 and 19 h. Food spillage was minimum and it was always returned to troughs before weighing. On days of AA administration the food consumed was weighed, in addition, at hourly intervals between 7 and 19 h.

Table 1
Amino acid composition of Nutramin Neo 8 % Spofa

Amino acid	g
L-Valine	3.00
L-Lysine HCl	3.75
L-Leucine	3.75
L-Isoleucine	2.30
L-Methionine	1.50
L-Phenylalanine	2.40
L-Threonine	2.05
L-Tryptophan	0.80
L-Arginine	6.00
L-Histidine	0.80
L-Aspartic acid	2.05
L-Glutamic acid	4.00
L-Alanine	1.70
Glycine	0.90
L-Proline	1.35
N-Acetyl-L-tyrosine	1.00
L-Cystine	0.18
L-Serine	2.85
Aqua pro injectione	ad 500 ml
pH	5-7
Energy content	686.5 kJ

A commercial solution of AA (Nutramin Neo 8 % Spofa, Czechoslovakia, see Table 1) was administered intraperitoneally to four groups of chickens at 2, 5, 12 and 20 days of age, to the remaining four groups at 3, 9 and 27 days of age in single doses of 1 g. \cdot kg⁻¹ (i.e. 12.38 ml.kg⁻¹) invariably between 6.30 and 7 h. The treatment on d 2 was repeated in another batch of 160 birds and the results were pooled. The groups not treated on the respective day served as controls. Sham i.p. injection of aqua pro injectione was carried out on day 8.

The significance of the results was assessed using the Student's t-test.

Results and Discussion

The growth rate of the broilers was characteristic of Hybro hybrids; their live body mass increased from 42 \pm 0.3 g (d 1) to 942 \pm 17 g (d 30).

Between 7 and 14 h (Fig. 1), the food intake of the experimental groups, except birds aged 2 and 3 d, was depressed: the actual consumption was 1/3 to 1/2 lower, compared with controls, on d 5, 9, 12, 20 and 27 (P < 0.01; P < 0.001; P < 0.05; P < 0.001; P < 0.05). Their relative food intake was affected similarly (P < 0.001; P < 0.001; P < 0.05; P < 0.001; P < 0.01).

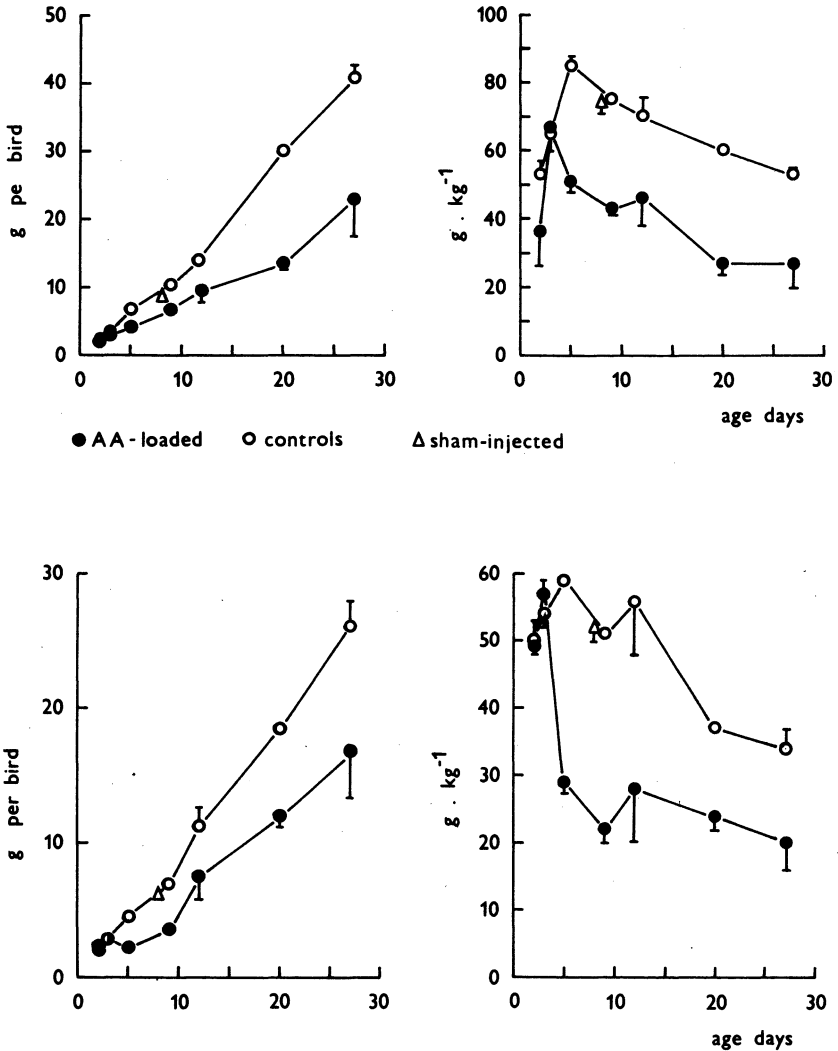


Fig. 2. Actual and relative food intake (\pm S.E.M.) of chickens between 14-19 h

Between 14 and 19 h (Fig. 2) the effect of AA load persisted in all experimental birds except those aged 2 and 3 d and the actual food intake of chickens was significantly depressed on d 5, 9 and 20 ($P < 0.001$; $P < 0.001$; $P < 0.001$), and the relative food intake on d 5, 9, 12, 20 and 27 ($P < 0.001$; $P < 0.001$;

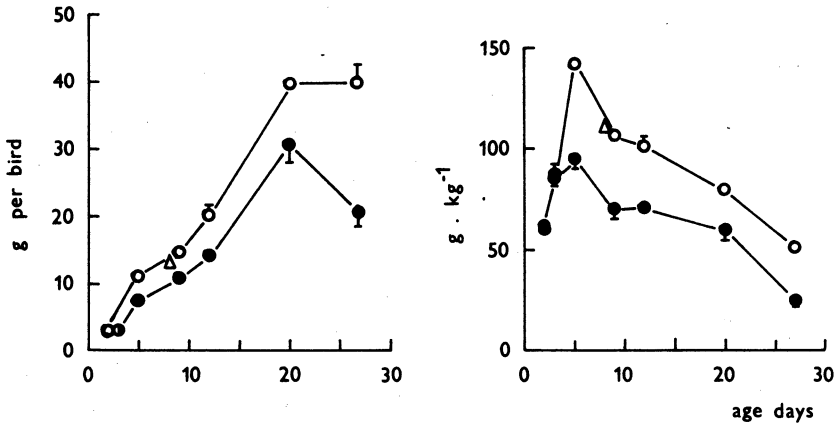


Fig. 3. Actual and relative food intake (\pm S.E.M.) of chickens between 19-7 h

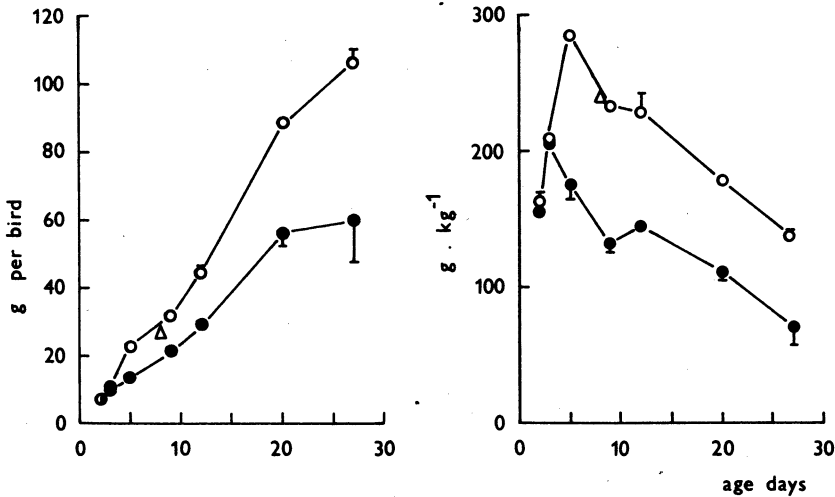


Fig. 4. Actual and relative food intake (\pm S.E.M.) of chickens per 24 h

$P < 0.05$; $P < 0.001$; $P < 0.05$). During this period of the day both the actual and relative food intake of the chickens was lowest.

Between 19 h and 7 h of the subsequent day (Fig. 3), AA administration exerted no effect on the food intake of 2- and 3-d-old birds but made itself still felt in those aged 5, 9, 12, 20 and

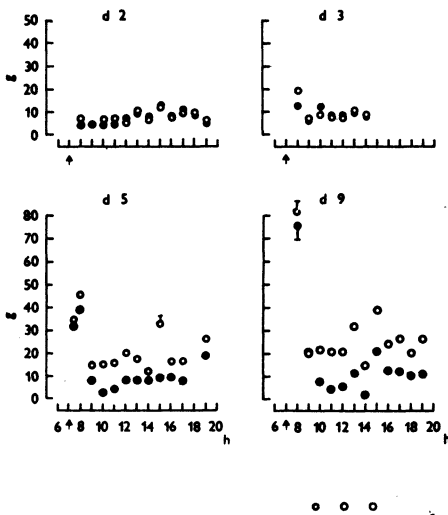


Fig. 5. Actual food intake of chickens aged 2 to 9 d (means \pm S.E.M. per groups of 20 birds) at hourly intervals (the arrows indicate the AA injections)

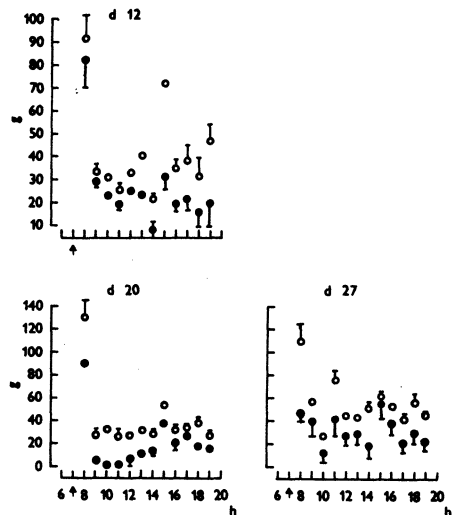


Fig. 6. Actual food intake of chickens aged 12 d (mean \pm S.E.M. per groups of 20 birds), 20 and 27 d (means \pm S.E.M. per groups of 10 birds) (the arrows indicate the AA injections)

27 d in both actual ($P < 0.001$; $P < 0.01$; $P < 0.01$; $P < 0.02$; $P < 0.001$) and relative ($P < 0.001$; $P < 0.001$; $P < 0.001$; $P < 0.02$; $P < 0.001$) values.

The persisting effect of the AA load made itself felt in cumulative food intake per 24 h (Fig. 4): whereas the food intake of AA-loaded chickens remained unchanged in birds aged 2 and 3 d, it showed a significant decrease on d 5, 9, 12, 20 and 27 both in actual ($P < 0.001$; $P < 0.001$; $P < 0.001$; $P < 0.001$; $P < 0.01$) and in relative ($P < 0.001$; $P < 0.001$; $P < 0.001$; $P < 0.001$; $P < 0.01$) values. This depression in food intake also affected the live body mass of otherwise rapidly growing broilers: e.g. on d 6 the chickens, loaded with AA the previous day, weighed 83 ± 1.3 g as against 97 ± 1.3 g of the controls ($P < 0.001$).

The food intake of chickens in response to AA administration was measured also at 1-h intervals (Fig. 5): practically no response was observed in birds 2 d of age. A decrease in food intake ($P < 0.05$) was observed in 3-d-old broilers but only in the first hour after AA administration. Chickens 5 and more d of age showed a different response: after the morning maintenance and AA administration they consumed the first and large meal similarly to controls (Baranyiová 1987) within 30 to 60 minutes. In 5-d-old AA-loaded birds this first portion was significantly smaller ($P < 0.05$) than in the controls. Their food intake showed consistently a highly significant depression until

the 12th hour ($P < 0.05$ to $P < 0.001$). In 9-d-old chickens this difference was even more pronounced although it became significant only from the 3rd hour onward ($P < 0.02$ to $P < 0.001$). In 12-d-old treated and control birds (Fig. 6), the morning meal was substantially larger but significant were only the differences in food intake at 3 ($P < 0.02$), 6 ($P < 0.001$), 7 ($P < 0.02$), 8 ($P < 0.01$) and 9 ($P < 0.01$) h after AA administration. The amounts of food eaten by the AA-loaded groups showed a considerable variability, especially in the last 6 h of measurement (e.g. by 11 h after AA administration the 4 groups ate 12, 10, 8 and 35 g). In 20-d-old chickens, the food amount eaten after AA administration was lower at 1 ($P < 0.05$), 2 ($P < 0.02$), 3 ($P < 0.001$), 4 ($P < 0.01$) h, compared with controls. On d 27, the AA-loaded birds ate significantly less ($P < 0.01$) than the controls only at 1 hour after AA loading. Later, the variability in food consumption between the AA-loaded groups continued to increase. Chickens sham-injected on d 8 showed no difference in food intake from intact birds.

Intraperitoneal administration of AA affected the food intake of chickens older than 3 d presumably as a result of induced intestinal satiety (Liebling, et al. 1975) with accompanying behavioural pattern (preening, beak cleaning etc.). The fact that the amount of energy supplied in the AA load did not surpass 1 % of energy consumed in the diet on the respective days provides evidence of a specific AA effect. This effect is apparently related to both the CNS structures (Blähser 1984) and the "independent integrative enteric nervous system" (Wood 1984). In this context it is of interest to note that serotonergic neurones in chicken CNS occur in brainstem by day 4 of embryonic development, in posterior hypothalamus on day 12 with most subdivisions of the central serotonin neuronal system described for the adult chicken brain recognizable (Wallace 1985), in the duodenum from day 9 with maturation of enteric serotonergic neurones towards the end of embryonic life (Epstein et al. 1980).

Tryptophan, precursor of serotonin, is generally considered to be the amino acid most involved in food intake regulation (Latham and Blundell 1979; Silverstone and Godall 1986). However, several other amino acids have been shown to be competitively involved in this regulation (Fernstrom and Wurtman 1972; Wurtman 1986) and to affect the concentration of tryptophan and/or serotonin in the brain (Peters and Harper 1984). In our experiment, a cumulative effect of AA appears to be involved as the tryptophan amounts contained in single Nutramin doses were well below its amounts that elicited changes in food intake in older birds (Lacy et al. 1986).

It can be concluded that the nutritional response of chickens to administration of AA is a function of age, that parenterally administered AA do operate as an aminostatic component in food intake control, that this component begins to come into play from d 3 after hatching, and that the response to AA administration varies during the early posthatching life.

Vliv intraperitoneální aplikace aminokyselin na příjem potravy broilerů v prvním měsíci života

Konzum krmiva broilerů Hybro starých 1 až 30 d jsme sledovali po i.p. aplikaci roztoku 20 aminokyselin (AMK) (Nutramin Neo 8 % Spofa). Kuřata byla rozdělena do 8 skupin po 20 a měla volný přístup ke krmivu (BR I a BR II) a k pitné vodě. Čtyřem skupinám byly AMK podány i.p. v dávce 1 g.kg⁻¹ ve 2., 5., 12. a 20. dnu, zbylým 4 skupinám ve 3., 9. a 27. dnu vždy mezi 6.30 a 7 h. Skupiny bez zátěže AMK sloužily jako kontroly. Pokus 2. dne jsme opakovali na 160 kuřatech a výsledky sloučili. Konzum krmiva všech skupin jsme sledovali v intervalech od 7 do 14, od 14 do 19 h, od 19 do 7 h, konzum za 24 h a také konzum v 1-hodinových intervalech do 19 h.

Podání AMK neovlivnilo příjem potravy u kuřat 2denních; pouze v 1. h po aplikaci AMK jej snížilo ($P < 0,05$) u kuřat 3denních. Od 5. do 27. d byl konzum krmiva pokusných skupin vesměs statisticky významně ovlivněn ve všech sledovaných intervalech, ale zejména mezi 2. a 12. h po aplikaci AMK. Podáním AMK byla u kuřat navozena sytost se všemi průvodními znaky chování. Parenterálně podané AMK tedy působí jako aminostatická komponenta regulace příjmu potravy, která se zřejmě u kuřat počíná uplatňovat od 3. dne po vylíhnutí. Mezi kuřaty starými 5 až 27 d jsme však v odpovědi na podání AMK našli rozdíly.

Влияние внутрибрюшинного применения аминокислот на прием пищи бройлеров на первом месяце жизни

Потребление кормов бройлерами в возрасте 1 - 30 суток исследовали после интраперитонеального применения раствора 20 аминокислот (AMK) (Nutramin Neo 8% Spofa). В двух сериях экспериментов использовали 8 групп по 20 бройлерах Гибро со свободным доступом к кормушке (БР 1 и БР 2) и питьевой воде. Подопытным группам на 2, 3, 5, 9, 12, 20 и 27 сутки после вылупливания интраперитонеально вводили 1 г.кг⁻¹ AMK в 6.30-7 часов, наблюдая за потреблением кормов в интервалах с 7 до 14, с 14 до 19, с 19 до 7 часов, потребление в течение суток, а также в часовых интервалах до 19 часов. В качестве контроля определили 4 группы цыплят. Дача AMK не оказала влияния на прием пищи цыплят в возрасте 2 суток, лишь за час после дачи AMK его понизило ($P < 0,05$) у цыплят в возрасте 3 суток. Начиная с 5 по 27 суток потребление кормов подопытными бройлерами статистически значимо уменьшилось во всех интервалах, в особенности в промежутке между 2 - 12 часами после дачи AMK. Дачей AMK была у бройлеров вызвана сытость со всеми отсюда следующими признаками поведения. Аминостатическая составляющая регулирования приема пищи, следовательно, начинается у бройлеров проявляться после 2 суток постинкубационного периода. Среди бройлеров в возрасте 5 и 27 суток в ответах на дачу AMK наблюдали различия.

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