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# EFFICIENCY OF PERCHLORIC ACID AMMONIA , AS A THYREOSTATIC AGENT IN BROILER RABBIT NUTRITION

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## INTRODUCTION

The use of antithyroid drugs as feed additive has got a long past (McDonald,1977).All the compounds whose anions decrease or occa - sionally inhibit the iodine uptake of the thyroid gland belong to this group: fluorides,thiocianates,nitrates,perchlorates.The two salts of perchloric acid - ammonium and magnesium - prepared in the Soviet Union belong to the latter group.The electronic structure of $ClO_4$ anion is similar to that of iodine.That's why it can inhibit through antagonism the iodine uptake of the thyroid gland and enhance iodine loss through the urine.Consequently the hormone production of the thyroid gland decreases,the intensity of cell oxidation abates,the oxygen consumption reduces,the N-retention elevates and the body produces less heat.The secretion of thyrotropin increases,however this increase cannot completely compensate the impairing effect of the drug if it is given in sufficient amounts( Selivanova-Vorobieva,1969).Once a new steady state establishes food utilization improves since the animal loses less heat and the productive proportion of the food increases(Solun et al.,1972).

Model experiments and those run under farm-conditions prove that both compounds (ammonia and magnesium perchlorate) improved the fattening indices of beef bulls, lambs,broiler chickens and ducks at a dose of 2-3 mg/kg body mass given daily.The average daily gain (ADG) and the food conversion ratio were better ,however the chemical composition of the body,the quality of the meat /water,protein and lipoid content/ and the OH-prolin/typtophan ratio did not change.The preparations completely empty from the organism within 24-48 hrs, so the withdrawal time is three days before slaughter (Selivanova et al.,1974).Experiments on meat rabbit showed that both perchloric acid ammonium and magnesium increased average daily gain by 3-5 g and improved food utilization by 8 - 13 % if given at a dose of 1-3 mg/kg body mass( Makarova and Rusakova,1978;Kubrakova and Mihailov,1979).Ruminant and poultry experiments prove that not only the decrease of the thyroid gland activity is the exclusive reason for the yield increasing effect: Ogaidsanov et al.(1970) report that the contents of the bowels proceed slower under the influence of perchloric acid ammonia and it results in better digestibility and utilization and in the increase of Nitrogen retention.

Our present model-like experiment on rabbits was carried out to widen the range of data accumulated up till now since neither u - tilization nor thyroid function was followed in the experiments available in the literature.

## MATERIALS AND METHODS

The perchloric acid ammonia ($NH_4ClO_4$)( PAA ) used is a white,hygroscopic crystalline powder of 117.5 MW.It easily dissolves in water (19 g/100 ml, at 20°C ),its diluted solution is of acidic reaction ( pH 5.4-5.5 ),its density is 1.95 g/cm$^3$.The $DL_{50}$ PAA is 4100 and 750 mg/kg body mass in white rat and in rabbit,respectively(Selivanova,1963;for review in English concerning the effect of this compound upon thyroid gland , see Wolff,1964).

Experiment I : PAA was mixed to the control food (Group I ) in 50 mg/kg (Group II ) and in 150 mg/kg (Group III ) before granulation. It is equal to a daily average of 5-15 mg/kg body mass. 32 six-weeks old New Zealand White rabbits were utilized throughout .Body mass was kept identical within a narrow range.In each group there werelitter mates of equal sex ratio.Animals were kept in individual cages with food and water ad libitum.Stabels were equipped with heating and airing system.Food consumption and body weight gain were measured individually every second week.Death was registered daily.Dead and sick animals were excluded from evaluation retrospectively.

Feeding trials were supplemented with utilization experiments.A total collection method was used: a 7 seven day pilot period followed by an 8 day main period.Collection and processing of fea - ces were carried out as suggested by Lebas (1979).The control food was tested on eight New Zealand White rabbits(5 months old).

Table 1
Composition value of the experimental food

| | | Calculated control | GroupI control | GroupII 50 mg | GroupIII 150 mg |
|---|---|---|---|---|---|
| dry matter | [%] | 90.00 | 91.95 | 93.30 | 93.60 |
| energy metab. | [MJ/kg] | 9.50 | - | - | - |
| starch equiv. | [ g/kg] | 573.00 | - | - | - |
| organic matter | [%] | - | 86.45 | 87.15 | 88.10 |
| crude protein | [%] | 18.00 | 18.43 | 18.55 | 18.14 |
| crude fibre | [%] | 11.50 | 11.50 | 11.20 | 11.20 |
| crude fat | [%] | 2.50 | 2.20 | 2.30 | 2.44 |
| N-free extr. | [%] | - | 54.32 | 55.10 | 56.32 |
| crude ash | [%] | - | 5.50 | 6.15 | 5.50 |

Experiment II : Six weeks old New Zealand rabbits were utilized in this study.Animals were assigned to 4 groups,10 individuals each.Group I: control;Group II: 15 mg PAA/kg body mass;Group III: 30 mg PAA/kg body mass and Group IV: 60 mg PAA/kg body mass.The drug was administered orally each day for 14 days.The dose given in this way corresponded to a 150,300,600 mg/kg food dose for the 15,30 and 60 mg/kg p.o.dose ,respectively.ADG, thyroxine (T4) and triiodothyronine (T3) serum concentrations were assessed at the end of the period,when animals were sacrificed.T4 and T3 RIA was carried out according to Pethes et al.(1978) .Initial hormone concentrations were estimited from sera collected on day 1 of the experiment.Statistical analysis was done according to Pearce,1965.

## RESULTS

The most important results of the feeding experiment until the age of 6-10 weeks are summarized in Table 2.The number of dead and sick animals were identical in all the three groups.Food sup-

Table 2
Experiment I.Results of fattening
( period:28 days,age: 6-10 weeks)

| | | Group I control | Group II 50 mg PAA | Group III 150 mg PAA |
|---|---|---|---|---|
| initial number | | 32 | 32 | 32 |
| final number | | 27 | 27 | 27 |
| death+desease | | 2+3 | 4+1 | 4+1 |
| fixed body weight ( 6 weeks old ) | [g] $\bar{x}$ | 11o4 | 1067 | 1068 |
| final body weight (10 weeks old ) | [g] $\bar{x}$ | 1919 | 1913 | 1978 |
| average daily gain | [g] $\bar{x}$ | 30.15 | 31.31 | 33.68+ |
| | $\pm s$ | 5:32 | 5.39 | 5.83 |
| food intake | [g/day] $\bar{x}$ | 1o1.96 | 103.52 | 105.14 |
| | $\pm s$ | 10.62 | 10.68 | 11.56 |
| feed/gain ratio | [kg] $\bar{x}$ | 3.44 | 3.36 | 3.18+ |
| | $\pm s$ | 0.46 | 0.46 | 0.46 |

+ $P < 0.05$ vs control

plementation with PAA resulted in favourable body mass increase.A 150 mg/kg dose showed significant ( $p<0.05$ ) daily body weight gain.Although rabbits consumed more from the food supplemented with PAA ,food conversion ratio improved because of the higher weight gain.Food utilization/unit body weight was also increased.

The results of digestibility study from Experiment I are shown in Table 3.The apparent utilization coefficient with 150 mg/kg PAA was higher than that of the untreated control ( $P<0.05$ ).No im -

provement was seen in the utilization of food containing 50 mg PAA/kg.It is interesting to note that the digestibility of crude fibre decreased in groups receiving PAA.

Table 3

Experiment I.Results of the digestibility study (n=4, $\bar{x}\pm s$, digestive coefficient in % )

| | Group I control | Group II 50 mg PAA | Group I control | Group III 150 mg PAA |
|---|---|---|---|---|
| organic matter | 75.61 | 73.38 | 73.57 | 75.65 |
| | 1.74 | 2.13 | 2.31 | 2.44 |
| crude protein | 74.63 | 73.77 | 71.84 | 76.34$^{+}$ |
| | 2.23 | 2.73 | 0.97 | 2.26 |
| crude fibre | 49.33 | 41.80 | 48.69 | 40.73 |
| | 4.15 | 6.00 | 1.75 | 7.39 |
| crude lipoid | 87.17 | 87.68 | 82.24 | 86.62$^{\oplus}$ |
| | o.81 | 0.76 | 3.48 | 1.44 |
| Nitrogen extract | 81.04 | 79.66 | 80.23 | 81.87 |
| | 1.70 | 1.40 | 1.67 | 1.97 |

$^{+}$ $P < 0.05$ $^{\oplus}$ $P < 0.10$

Experiment II is visualized in Table 4.Thyroxine (T4) and triiodothyronine (T3) serum levels dropped significantly ( $p<0.05$) in Group III and Group IV,but no change was observed vs. control if only low dose ( 15 mg ) of PAA was administered.High doses ( 3o,60 mg PAA ) depressed thyroid function and no increase in ADG could be confirmed.The low dose ( 15 mg PAA ) did not alter thyroid function but caused a significant elevation in ADG.

Table 4

Experiment II.Results of T4 and T3 serum concentrations and that of ADG (T4,T3 are given in ng/ml, $\bar{x}\pm$SEM(n=8-1o; ADG is given in gramm )

| | T4 before feeding | T3 before feeding | T4 after feeding for 14 days of PAA | T3 after feeding for 14 days of PAA | ADG at the end of the period |
|---|---|---|---|---|---|
| Group I | | | 28.9±3.0 | 0.58±0.10 | 21.5±2.o8 |
| Group II | 29.7±3.1 | 0.75±0.09 | 30.1±1.8 | 0.72±0.07 | 37.0±2.42$^{\oplus}$ |
| Group III | (n=18) | (n=16) | 17.0±3.2$^{\oplus}$ | 0.35±0.07$^{\oplus}$ | 19.5±1.49 |
| Group IV | | | 15.7±1.9$^{\oplus}$ | 0.32±0.05$^{\oplus}$ | 14.2±0.77$^{\oplus}$ |

$^{\oplus}$ $p<0.05$ vs.Group I and/or vs. "before feeding"

## DISCUSSION

Perchloric acid ammonia ( PAA ) improved average daily gain (ADG) either if given in the food at a concentration of 150 mg/kg(Exp.I) or when administered orally in a dose of 15 mg/kg body mass corresponding to 150 mg PAA/kg food(Exp.II).A moderate effect was also observed with lower doses in Exp.I (50 mg PAA/kg food).These results are in accordance with the findings of Makarova and Rusakov (1978) and with those published by Kubrakova and Mihailov (1979).

On the basis of digestibility studies it can be accepted that the yield improving effect of PAA can be ascribed to its ability to enhance protein and lipoid digestibility.

Thyroid activity was not depressed by PAA in a dose of 15 mg/kg body mass.Higher doses on the other hand ( 30,60 mg PAA/kg body mass p.o.) caused significant decrease in the serum level of thyroxine (T4) and triiodothyronine (T3) after 14 days of application.These results suggest that the benevolent effect of PAA on food digestibility and perhaps on utilization is not closely related to the thyroid-suppressing ability of this agent.This latter supposition is in contrast with the oppinion of Ogaidsanov(1970) and Antonov(1979) who supposed a thyroid mediated action mechanism.A much more plausible reason for the yield improving effect might serve that suggested by Wolff (1964),Abd-el-Hafiz et al.(1978) and partly by Ogaidsanov(1970),namely the depressing of motility of the gastro-intestinal tract.In this way the passage of food slows down and digestibility,utilization and N-retention increase.

At present the perchloric acid ammonia (PAA) is not licensed in most of the countries ( eg. Hungary,USA ).It is temporarily licensed in the USSR,where extensive study is carried out concerning its applicability.

Further studies under large-scale conditions are required to justify the above results both from physiological/hygienic and from economic point of view.

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SUMMARY

The effect of perchloric acid ammonia (PAA) on fattening,digestibility and on thyroid function was studied in two experiments.Exp.I: New Zealand White rabbits were given control food (group I ), control food+50 mg PAA/kg (Group II) and control food+150 mg PAA/kg (Group III).Fattening and digestibility study was carried out.Results bespeak of a benevolent effect of PAA on both fattening and digestibility.Protein and lipoid digestibility were the main factors responsible for the yield improving effect.Exp.II:PAA was administered p.o.in doses corresponding to 0,150,300,600 mg PAA/kg food for 14 days New Zealand White rabbits.Thyroxine and triiodothyronine serum levels were significantly depressed when 300 or 600 mg PAA was given,but no change of hormone concentrations were observed when administering 150 mg PAA,however the latter dose solely enhanced average daily gain similarly to that in Exp.I.
Results suggest that the favourable effect of PAA is due to its impact on digestibility rather than to its thyroid-suppressing effect.

Résumé

Les auteurs donnaient aux lapins de l`engraissement trois types de l`aliment: control et celui qui été comleté que de 50 mg/kg ou bien 150 mg/kg l`ammonique perchlorique.Les investigations out été complétées aussi par des expériences de digestibilité.Les aliments contenant d`ammonique perchlorique étaient très favorables pour les résultats de production,le teneur à l`ordre de mg/kg 150 a déjà amélioré significativement legain moyenne quotidien (GMQ) et l`indice de consommation.Distribué en doses à la l`ordre mg/kg 150 la digestibilité apparente de la proteine et de la graisse se sont améliorées.Les résultats plus favorables peuvent être attribués à l`amélioration de la digestibilité,parce que l`activité thyrodienne auprés de la dose de 150 mg/kg n`a pas été influencée ,par coutre sur des doses plus élevées (300 et 600 mg/kg) la teneur sanguine de T4 et T3 ont diminuées significativement.

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