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AMMONIA EMISSION AS AN ENVIRONMENTAL THREAT

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Summary. An excessive supply of ammonia to atmosphere constitutes one of the causes of anthropogenic eutrophication. Assessments of the emission of this gas are very diversified, and the greatest discrepancies refer to the emission of NH_3 from animal production. These discrepancies made us trace the general amount of nitrogen in poultry brood depending on two parameters having a decisive influence on the dynamics of quantitative changes of this chemical element – time and temperature. In general, nitrogen content decrease during incubation, and the higher the temperature, the greater the intensity of the decrease. However, it turned out that it is the first three days of incubation, during which nitrogen loss in the brood is from 30 to 42%, which decides about the amount of nitrogen loss without regard for temperature value. In the next 11 days nitrogen loss is considerably smaller. Losses, depending on the temperature, reach the level from 53 to 59%.

Key words: ammonia emission, anthropogenic eutrophication, poultry brood

INTRODUCTION

According to Radwan [2003], bio-diversity constitutes the measure indicating diversification both within species and ecosystems as well as between them. Biological diversity is composed of, in ecological approach, the variety and changeability of organisms. This is formed on four basic levels: genetic, species, ecosystem-habitation and scenic. Learning the dependence between species diversity and its higher levels, i.e. ecosystem and scenic diversity, as well as factors influencing the shaping of species diversity, constitutes one of the most significant ecological problems. Poland is a country in which both species diversity as well as habitation-ecosystem diversity are very rich. According to the above author, of particular value are specific, unmet in Europe, land, peat and water ecosystems. That is why the preservation of these ecosystems in their unchanged state is important.

The direct cause of the worsening of the state of ecosystems is an excessive influx of biogenes triggering off the growing eutrophication of environments. This causes changes in the number, structure and species composition. Slow eutrophication, taking place for

natural reasons, contributing to ecological succession, does not constitute a problem for changes in ecosystems. What constitutes a problem is eutrophication following human actions, which is caused by enriching ecosystems in nutrients, in particular, nitrogen and phosphorus as well as organic matter [Tusseau-Vuillemin 2001].

One of the causes of anthropogenic eutrophication is an excessive supply of ammonia to atmosphere. In Poland in 1994 it was estimated to constitute 326000 tons of N [Sapek 1996]. The world emission of this gas is estimated to be between 45 and 75 million tons annually [Pacyna and Graedel 1995, Rodhe 1995]. However, the estimate of this emission is highly diversified. The greatest discrepancies refer to the emission of ammonia from agricultural production, in particular animal production. Discrepancies in estimates of the emission of ammonia from farm animal rearing are the result of the choice of emission scalers assumed for the European Union countries. These made us trace changes of the general amount of nitrogen in poultry brood when kept in varied temperature, that is two parameters of paramount importance for the dynamics of quantitative changes of this chemical element in the material under scrutiny. The third essential parameter which decides about the dynamics of biological changes is the dampness of the material in which they take place. The influence of this parameter on the kinetics of changes has not been determined, maintaining in the experimental arrangements constant dampness of the material on which experiments were conducted.

The aim set forth was fulfilled by conducting experiments according to the researchers' own experimental model.

MATERIAL AND METHODS

The material on which the experiments were conducted was fresh poultry brood coming from poultry kept in the cage system. Portions of ca. 300 grams of fresh brood were placed in plastic containers in which it constituted a layer of ca. 5 centimetres in thickness. The containers with the brood were placed in plastic airtight boxes. In this way the researchers formed samplers enabling them to trace changes in nitrogen content under the influence of time and temperature in which the brood was kept. The samplers were placed in thermostats at temperatures of 15°C, 25°C and 35°C. Each day of the incubation conducted for 14 days a piece of ca. 4 grams of brood was taken off the samplers, which was dried at a temperature of 105°C until stable weight. Next, nitrogen content was marked in samples prepared in this way by means of the Kiejdahl method.

RESULTS AND DISCUSSION

Percentage general nitrogen content in the dry mass of brood incubated for 14 days at temperatures of 15°C, 25°C and 35°C is shown in Fig. 1.

5.5% of nitrogen was found in the dry mass of fresh brood. However, its amount rapidly decreased during incubation. As early as after 3 days of incubation its content fell to 3.75% in samples incubated at 15°C. Somewhat larger decreases were observed in samples incubated at temperatures of 25°C and 35°C. These samples contained 3.25% of nitrogen. After 7-day incubation, general nitrogen content, in samples incubated at tem-

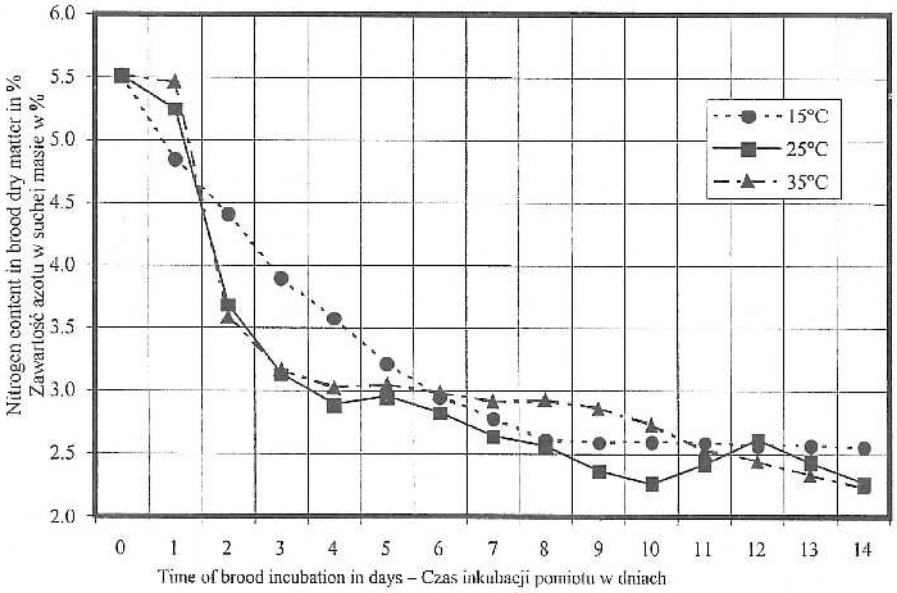

Fig. 1. Proportional nitrogen content in dry matter of brood incubated in temperatures (15, 25 and 35°C)
Rys. 1. Zawartość procentowa azotu ogólnego w suchej masie pomiotu inkubowanego przez 14 dób w zróżnicowanej temperaturze (15, 25 i 35°C)

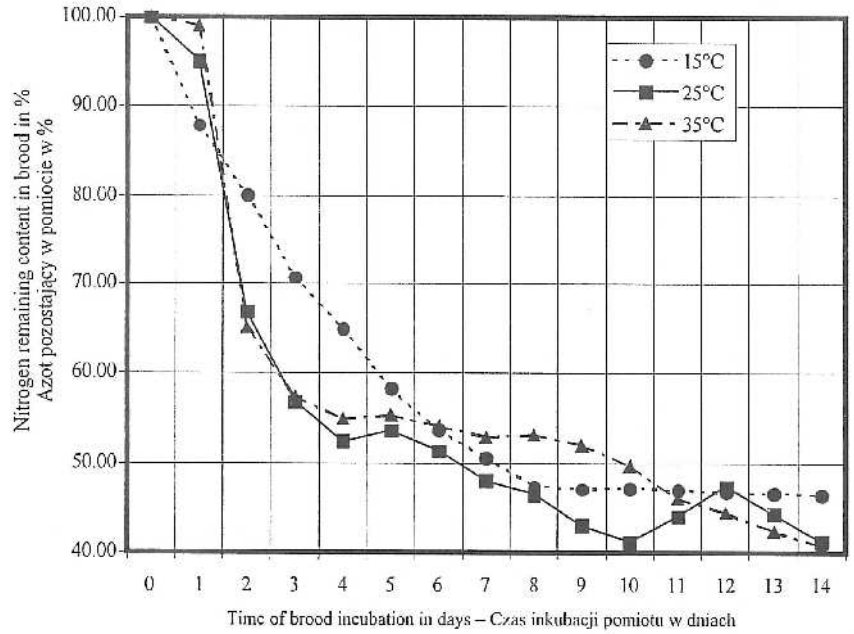

Fig. 2. Proportional content of nitrogen remaining in brood during incubation in divergent temperatures (15, 25 and 35°C)
Rys. 2. Zawartość azotu pozostającego w pomiocie w czasie inkubacji w zróżnicowanej temperaturze (15, 25 i 35°C)

peratures of 15°C, 25°C and 35°C, was 2.75, 2.25 and 2.80%, respectively, whereas after 14-day incubation, nitrogen content, in samples incubated at a temperature of 15°C was 2.60% and at temperatures of 25°C and 35°C it was 2.25%.

Percentage changes of the nitrogen left in the brood are shown in Fig. 2. The values received are somewhat shocking since as early as after 3-day incubation there was 72% of nitrogen left in samples incubated at a temperature of 15°C, and in samples incubated at temperatures of 25°C and 35°C there was only 57% of nitrogen left. On the other hand, after 7-day incubation these values were at 50, and 47 and 53%. After 14-day incubation 47% of nitrogen was found in samples incubated at 15°C, and there was only 42% left in samples incubated at temperatures 25°C and 35°C. Percentage nitrogen loss is shown in Fig. 3.

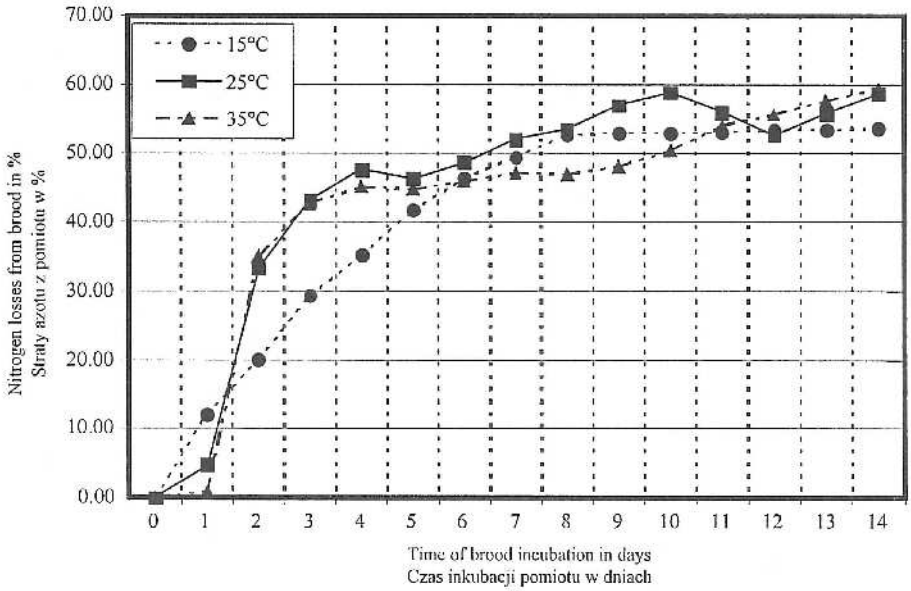

Fig. 3. Proportional nitrogen losses from brood incubated in divergent temperatures (15, 25 and 35°C) during 14 days

Rys. 3. Straty azotu (w procentach) z pomiotu inkubowanego w zróżnicowanej temperaturze (15, 25 i 35°C) przez 14 dób

The graphs show that no matter what the temperature was, the first three days of incubation were decisive for the volume of nitrogen loss. It is at this time that 30-42% nitrogen loss from the brood was observed, while during the remaining 11 days of incubation the losses went up from 53 to 59%.

The nitrogen losses observed were surprisingly high. However, they remain to be in conformity with the results achieved by other authors [Brewer and Costello 1997, Koerkamp *et al.* 1998, Pain *et al.* 1998, Kithome *et al.* 1999, Misselbrook *et al.* 2000].

CONCLUSIONS

The experiments demonstrated that nitrogen content in poultry brood depends on both the time and temperature of incubation. Generally, the largest loss of nitrogen is observed during the first three days of incubation in all the temperatures, 15°C, 25°C as well as 35°C.

As has already been noted, in the experimental arrangements constant dampness of the material on which experiments were conducted was maintained. However, owing to the fact that dampness, similarly to time and temperature, constitutes a fundamental parameter determining the dynamics of biological changes, it seems justified to consider this parameter in the following stages of the experiments.

Learning about the transformation of nitric compounds in precisely delineated experimental conditions can serve to predict the volume of ammonia emission from animal manure. The precise specification of ammonia emission to atmosphere may allow to determine the influence of ammonia emission on the environment and to make it possible to draft effective mechanisms limiting ammonia emission to atmosphere, which may become an essential element of an environmental protection strategy.

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EMISJA AMONIAKU JAKO ZAGROŻENIE ŚRODOWISKOWE

Streszczenie. Nadmierna podaż amoniaku do atmosfery jest jedną z przyczyn antropogenicznej eutrofizacji. Oceny emisji tego gazu są bardzo zróżnicowane, a największe rozbieżności dotyczą emisji NH_3 z produkcji zwierzęcej. Rozbieżności te stały się inspiracją do prześledzenia ogólnej ilości azotu w pomiocie drobiowym w zależności od dwóch parametrów, mających zasadniczy wpływ na dynamikę zmian ilościowych tego pierwiastka – czasu i temperatury.

Generalnie zawartość azotu malała w czasie inkubacji, a intensywność spadku była tym większa, im wyższa była temperatura. Okazało się jednak, że o wielkości strat azotu bez względu na wartość temperatury decydują pierwsze trzy doby inkubacji, w czasie których ubytek azotu z pomiotu wynosi od 30 do 42%.

W kolejnych 11 dobach ubytek azotu jest znacznie mniejszy. Straty w zależności od temperatury osiągają poziom od 53 do 59%.

Słowa kluczowe: emisja amoniaku, antropogeniczna eutrofizacja, pomiot drobiowy