THE EXAMINATION OF POULTRY FEATHER DIGESTILITY FOR BIOGAS PRODUCTION

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Introduction

Certain bacteria and fungi are able to hydrolyze keratin with the help of special proteases, the keratinases. Several species belonging to the genus *Streptomyces* and *Bacillus* are capable of this process (Williams et al., 1990; Bressollier et al., 1999), as well as some saprophyte, parasitic fungi (Dozie *et al*., 1994), *Actynomycetes* (Noval and Nickerson, 1959; Böckle *et al*., 1995), *Fervidobacterium pennavorans* (Friedrich, 1994)**.** Some *Bacillus* species *(B. polymyxa, B. licheniformis, B. brevis, B. subtilis)* are able to produce antibiotics (polymyxin B, gramicidin, tyrocidin, edein, bacitracin). Some species are important for the production of industrial enzymes, such as alkaline protease in detergents and a-amylase (Pesti, 2000). *Bacillus licheniformis* is used for industrial fermentation, as it synthesizes large amounts of such exo-enzymes as proteinase and amylase beside antibiotics (Kevei, 2002).

In this study the digestibility of poultry feather was examined, with the use of *Bacillus licheniformis* for biogas production. The high protein content of poultry feather makes it an excellent raw material for biogas production. The digestion by fermentation of this difficultly disintegrating material produced in large quantities provides an environmentally-friendly way of utilization. Our objective was to determine the timing of application and the maximal amount of pre-processed feather for digestion, to optimize the concentration of disintegrating microorganisms and examine their reproduction and to elaborate a biomass recipe with optimal C:N ratio for maximal specific biogas production.

The fermented by-product of biogas production has several favourable properties in contrast to untreated manure and inorganic fertilizers (Szegi, 1967). The digested plant nutrients from organic materials are more easily accessible compared to traditional fertilizers. The N-, P-, S-, and microelement content of the produced “organic /bio” fertilizer is remarkable, so its application can be an environmental friendly means of nutrient supplementation (Tarnawa and Klupács, 2006; Németh, 2006**,** Juhász et al., 2006).

Material and methods

Eight experiments were conducted in the laboratory of the Department of Water- and Environmental Management, University of Debrecen between 09. 01. 2006 and 10.15. 2006. In the first step the heat treatment of the feather was carried out in a cooker at a temperature of 70, 100 and 140°C, then the optimal feather:water ratio was determined by examining feather: water ratios of 1:1, 1:2 and 1:3 *(Table 1)*. The ratio of 1:1 (1kg feather: 1 liter of water) proved unsuitable for mechanical mixing, so its application under industrial-scale operation is not recommended. At the ratio of 1:2 0,67 kg of

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feather was mixed with 1,33 liters of water., while at the ratio of 1:3 0,5 kg of feather was interspersed with 1,5 liters of water. The optimal digestion temperature of 42°C and a pH between 6,5-8 in the solution was ensured by adding 5-5 milliliters of phosphate-buffer to each treatment coupled with the application of a thermostat. The ratio of feather: *Bacillus licheniformis* (%) was ensured by inoculating 1, 3 and 5% of *Bacillus licheniformis* culture to the feather. During the first experiment the cell number in the bacterium culture was determined with a Bürker-cell/chamber before inoculation, as well as the extinction in the range of 605 nm with a photometer. In the further experiments the cell numbers were determined with the calculated calibration curve by turbidimetric method based on the extinction of the solutions. All possible combinations were tested in a series of experiments applying four treatments and one control group in each experiment. Temperature, pH and extinction (turbidity) was measured in every three hours. In the controls only the feather: water ratio was set. The combinations showing the best extinction (between 5-12) and homogeneity values were repeated.

Table 1. Set of experiment

Feather:water ratio / **Feather:microbe ratio**	**Pretreatment (°C)**								
	70 °C			100 °C			140 °C		
	1%	3%	5%	1%	3%	5%	1%	3%	5%
1:1					A	A			
1:2	E, G	E	F	D	B	B	C	C, F	G
1:3	D, E, G, H, I	D, E	F	D	A	A	C, F	C	G

Results and discussions

Evaluation of pH data: After setting the feather: water ratio, 5-5 milliliters of phosphate buffer was added to adjust the pH in the treatments. The pH of control treatments were measured 7,2 (slightly alkaline). Due to bacterial activity the pH decreased in all treatments, with pH often in the range of slight acidity. The stabilization of pH could be resolved by adding a maximum of 5-15 milliliters of phosphate buffer. An occasional shift in the pH was observed, which could be explained by the intensive increase of bacterium numbers (pH decrease), extreme aeration (excessive aeration- pH increase) and excessive amounts of feather.

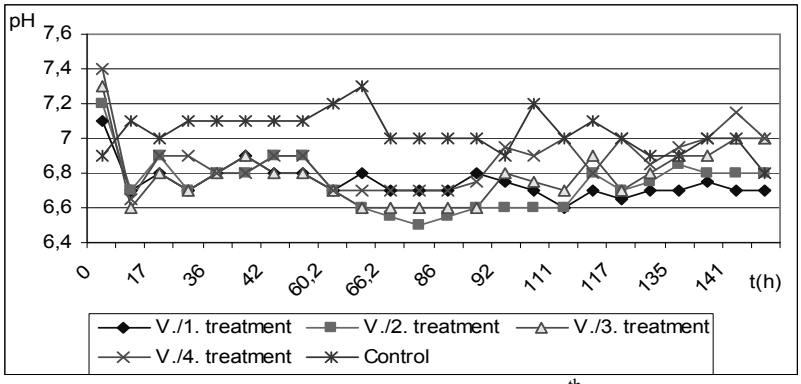

Figure 1. Changes of pH in the case of 5. th experiment