INFLUENCE OF ANIMAL BY-PRODUCTS FROM ABATTOIR ON COMPOSTING PROCESS

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Introduction

The animal by-products from abattoir were till now not being used as component in composting in Slovenia. According to the EC directive 1774 and the Slovenian legislation the use of ABP from abattoir as raw material additive in composting became an option (3;5). In Republic of Slovenia an average of 70.000 tons of the APP is being generated yearly. ABP are treated in three rendering plants. More then 80% of animal by products from abattoir belong to category three materials. Treatment of ABP presents a significant cost for food proceeding industries (approximately 204 EUR per ton). In our investigation we studied the influence of ABP addition on composting process. The purpose of this presentation is a case description of ABP addition to the "usual" compost mixture.

Material and methods

In our investigation we used insulated bioreactor vessels (1x1x1m) of $1m^3$ of volume. A composting mixture of sheep manure and pine bark with addition of water has been used so that content of moisture reached approximately 65%. In the study mixture, 20% of ABP of sheep from abattoir were added to the mixture after being cut into small pieces and homogeneously mixed. Temperature was controlled with PT 100 probes using computer program "Visi DaQ" ® (Advantech, USA) and measured every minute on the tree vertical levels (16 cm, 50 cm and 66 cm above bottom) and 30 cm deep in material. Temperature was limited upward to 65°C and was maintained in vessels by fans which were used for aeration of material as well. The moisture of composting material was determined by sample weighing (Exacta -Tehnica Železniki, Slovenia) before and 24 h after drying at 105-110°C. pH was determinate using calibrated pH meter (Iskra, Slovenia) in a compost extract made by mixing compost sample dried at 105-110°C (5g) with distilled water (25g) and stand of 10 minutes. By Kjehldal method where total nitrogen determinate. Ammonia was determinate by titration method. We mixed in round flask 10g of sample, 250 g H_2O, 3g MgO, 50 ml 0,1 mol H_2SO_4

and metal red dye. After distillation of 150 ml of fluid we titrated it with 0,1 mol NaOH. Ash was determined with beam method at 550^{o}C 30 min and weighing with 0.0001g accuracy.

Results

Average temperatures were higher in all layers of composting mixtures with ABP in first three days but difference was statistically significant only in the lowest layer (P<0,00). Temperature decreased successively after seven days. Differences between temperature in upper (2,9^{o}C – higher in usual compost mixture) and lower layers (0,9^{o}C - higher in compost mixture with ABP) of compost mixture and mixture with ABP were statistically significant (P<0,00) during 21 days. In middle layer difference wasn't significant (P<0,43) and was 0,04^{o}C – higher in compost mixture with ABP than in the control group. Comparison of average temperatures between all the layers established a difference of 0.39^{o}C (higher in usual compost mixture) that was not statistically significant (P<0,20) (Figure 1). Correlation of measured temperatures was high (r=93).

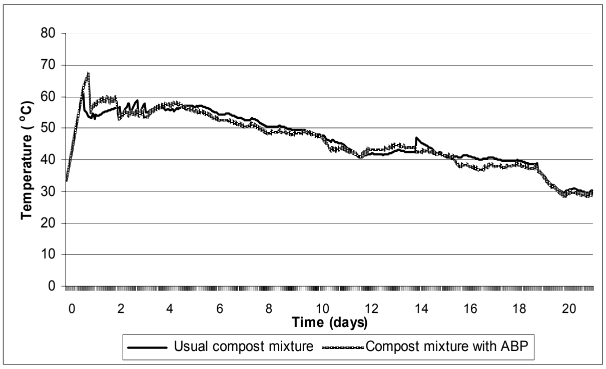

Figure 1: Temperature trends during 21 days for mixtures studied.

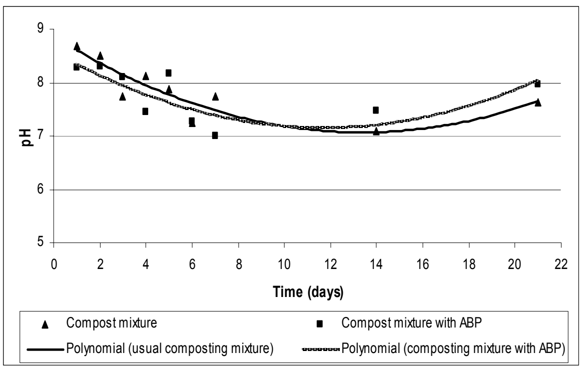

Figure 2: pH values during 21 days for mixtures studied

pH values where above 8 at the beginning of composting and dropped below 8 on the third respectively fifth day of the study and persisted below that value until day 21(Figure 2).

Table 1: Results of chemical analyses of the control mixture:

Sampling day*	Moisture (g/kg)	pH	Ash (g/kg)	Total nitrogen (g/kg)	Ammonia (mg/kg)
1	607,6	8,69	177,9	117,0	3900,4
2	706,2	8,50	**/	**/	**/
3	608,0	7,75	**/	**/	**/
4	635,6	8,13	**/	**/	**/
5	603,3	7,88	**/	**/	**/
6	574,7	7,24	**/	**/	**/
7	493,2	7,74	212,1	31,9	3063,8
14	451,6	7,09	**/	**/	**/
21	516,5	7,64	245,7	28,3	872,4

*n=2; **/=not determine

Table 1: Results of chemical analyses of compost mixture with ABP:

Sampling day*	Moisture (g/kg)	pH	Ash (g/kg)	Total nitrogen (g/kg)	Ammonia (mg/kg)
1	653,2	8,27	201,3	132,4	4413,2
2	670,0	8,30	**/	**/	**/
3	606,4	8,09	**/	**/	**/
4	644,7	7,44	**/	**/	**/
5	597,4	8,17	**/	**/	**/
6	625,9	7,26	**/	**/	**/
7	505,1	7,01	295,1	45,0	3010,5
14	515,7	7,47	**/	**/	**/
21	576,3	7,97	312,2	41,8	1098,4

*n=2; **/=not determine

Discussion and conclusions

During our study, we did not observe the usual two stage increases in temperature (2;2). Probably, the biodegradation has started in the deep litter and was continuing after beginning of aeration. Higher temperatures in composting substrates indicate a more active biodegradation of the material (1;4). ABP content of fast degradable substances for microbial decomposition and fast increase of temperature at the beginning of the process is a result of their degradation. Tiquia et al described a decrease in moisture during composting processes due to active aeration (9). In our study, lower moisture content was observed after the forth day of the experiment (Table 1). The moisture content in the ABP mixture was in average 3,7% higher than in the control group. At the beginning of the composting ammonia was present in all samples in high concentrations. In manure, ammonia originates from biodegradation of the proteins and the urea acid (7). Elimination of NH_3 and NH_4+ from the manure depends from pH, temperature (7) and air flow (10). We believe that high content of ammonia was the result of biodegradation and low concentration of oxygen in raw material – deep litter of sheep manure. Total nitrogen content values where higher in ABP mixture samples. In the composting mixture, pH level at the beginning of composting mixture was above the value that is described as optimal (2;8). The high values of pH could be attributed to the high content of ammonia. The quantity of the ash was higher in samples that had been taken on day seven and 21 in comparison to the first samples. During the composting process the ash increases due to the loss of the organic fraction or volatile solids as CO_2 and is crude indicator of extent of composting (6). In our study we found differences in composting process between composting mixtures with or without ABP. However, the differences were not statistically significant we lacked sufficient data. We can conclude that an addition of ABP to the usual compost mixture in our study did not significantly influence the composting process. Considering the provisions in EC directive 1774 and by suitable maintaining of composting process, composting could present a simple solution for ABP treatment. For additional evaluation of the method more samples and repetition have to proceed.

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