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Texture of dry cat foods and its relation to preference

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ABSTRACT

Structure analyzer devices were constructed for individual breaking and compression force measurement for dry cat foods. Three commercially available products with different flavors (chicken, lamb, tuna) of two manufacturers (premium and good quality) were examined. The self-developed devices were fitted to a computer-controlled structure test equipment. From a methodological point of view the different granule size and a curved granule surface cause uncertain results with the application of individual breaking device. However the cat food structure characterization with the compression measurement device was successful. The measured force values varied between 0.9 and 1.38 N/mm^2. According to the results of a parallel animal preference test the feed consumption values were remarkably different between feed types. Concerning the feed intake of the most and least preferred cat foods more than fivefold difference (75 vs. 420 g) was measured. With joint evaluation of the structural and preference results the hardest product proved to be the most favorable for the cats. Interestingly the compression force and also the feed intake sequence proved to be identical in case of the measured cat food products.
(Keywords: cat, pellet hardness, feed preference)

INTRODUCTION

Commercial cat foods can be classified as wet, semi-wet or dry products. Dry foods typically with less than 12 percentage of water content are available in extruded, granulated, farinaceous form or a kind of biscuits. Traditionally the physical quality of extrudes can be characterized by the hardness and the structural stability which parameters have an outstanding importance in feed industry. According the results of *Tran et al*. (2011) the temperature, the duration of drying time, the particle size and the moisture content have remarkable effects on hardness and structural stability. These physical parameters are important not only from animal but also from packaging and transporting point of view as the breakable granules lead to quality problems.

The so-called plaque development of dogs and cats can be considered as a serious health problem. The tartar coated teeth provides excellent conditions for microorganism colonization causing inflammation, unpleasant breath and as a final result loosing of the teeth. The proper chewing helps to clean the teeth especially in wild animals getting more natural feed than our pet animals. However commercial pet foods are available which were developed considering the recognized correlation within pellet hardness and the level of plaque formation (*Cupp et al*., 1999). The relationship of feed hardness and the occurrence of certain diseases – or more general the life quality were examined by *Bailoni and Cechiaro* (2005) in case of old dogs.

The producers identify the palatability as a measurable parameter of feed preference and feeding behavior. These measures are determined by the sense of taste, aroma, shape, particle size and structural characteristics (*Tran et al*., 2008). The feed preference of cat is mostly depending on the feed's smell which can be affected by microbiological contamination, rancidity, aroma distortion or in some cases structural degradation of the product (*Deffenbaugh*, 2007). It is well known that the hardness of feed particles have remarkable effects on feed preference of *animals in general* (*Skoch et al*., 1983). *According to the experiment of Trivedi* and Benning (1999) the cat rejects feed containing sharp particles which could cause injuries within the mouth or the stomach of the animal.

Aims: Method development and measuring device construction for dry pet food structure characterization based on the use of a universal texture analyzer. We also aimed to compare the animal acceptance and the structural characteristics of commercial cat food samples.

MATERIAL AND METHOD

The structural studies were carried out in the Laboratory of Kaposvár University Institute of Food and Agricultural Product Qualification by a computer-controlled structure analyzer type: ZwickRoell Z005. For the measurements self-developed devices were constructed considering the work of *Thomas and van der Poel* (1996) as basis. Two types of measurements (individual breaking and compression) were performed. The force on the measuring cell and the maximum compression force per unit area (N/mm^2) were continuously recorded with testXpert V11.0. software during the snap or the volume changes of the sample, which is directly related to the energy needed by the chewing process of the animals.

In the course of the methodological studies, we investigated the hardness of the commercially available dry cat foods. Three different flavored products (chicken-A, lamb-B, tuna-C) of two manufacturers in two different quality categories (premium-1 and good-2) were compared during our study.

The samples used in the structural analysis, were also independently analyzed by preference tests at Szent István University, Faculty of Veterinary Science, Department of Animal Breeding, Nutrition and Laboratory Animal Science. Based on sample selection and the implemented procedure, the cats could choose between three different feeds **(**chicken, lamb, tuna**)** from the same manufacturers per trial. These choices came from two (premium, good) different manufacturers. The 8 cats were kept in individual cages and were feed *ad libitum*. The feed consumption was recorded for 8 consecutive days.

The calculated average values of the recorded maximum shear force per unit area (N/mm^2) measured during the experiments were tabulated and graphically presented with Microsoft Excel 2010. For the statistical analysis (One-Way ANOVA), IBM SPSS Statistics 20 software was used. In order to compare the treatment means, Tukey test was applied ($P=\geq 0.05$) and finally, correlation analysis was performed to calculate the relationship between the studied variables.

RESULTS AND DISCUSSION

Device development

For the individual breaking of the food grains we designed a special, stainless steel pressure piston, with a diameter of 10 mm and round shaped, horizontal surface that exerted the pressure on the sample (*Picture 1*). The sample was placed on a horizontal, circular shaped appurtenance; an anvil with a diameter of 20 mm, which was approached by the moving piston with 50 mm/min speed. The distance between the anvil and the pressure piston was 16 mm in the starting position. The piston moved a distance of 14 mm during the measurement, causing the food sample to be tested to collapse under the generated pressure. For a given product, a set of 50 food grains were measured. Prior to the experiments, it was necessary to define the average cross section for all products in order to ensure the accuracy of the measured shear force by the instrument, since the use of incorrect cross section values could lead to the bias of the measured results and therefore an erroneous interpretation of them.

A 50 mm high and 50 mm inner diameter, stainless steel cylinder was prepared to perform the compression measurements (*Picture 2*). Inside the above specified cylinder, there was a solid piston of stainless steel (height: 12 mm, diameter: 44 mm) which was used for the compression. During this phase of the procedure, the piston compressed the samples only to 80% of original volume. The piston speed was 50 mm/min. The measurements were repeated 15 times.

Picture 1. Breaking device

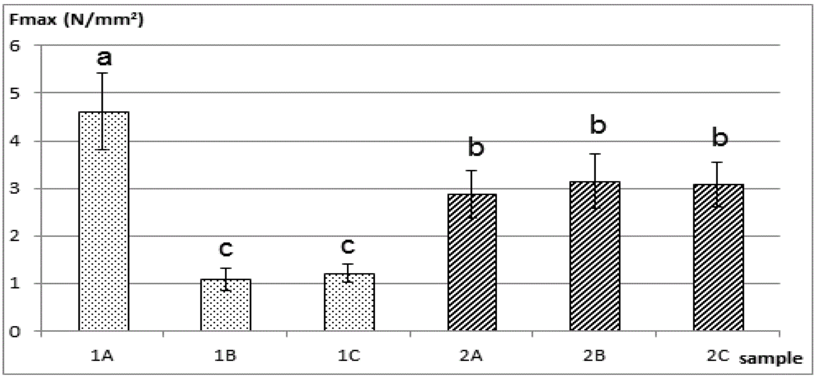
Picture 2. Compression device

Individual breaking of the granules

Remarkable differences were determined within the maximum breaking force values of the measured pet foods (*Figure 1*). The samples of the first producer can be divided into two well separated groups with significantly different force resistance. In case of the second brand the force measurement resulted similar values independently from the composition of the sample. Interestingly feeds with identical ingredient contents shows remarkably different structural characteristics presumable due to their manufacturing technology.

Figure 1

The maximum force required to individual breaking of feeds



Where: 1-premium, 2-good; A-chicken, B-lamb, C-tuna

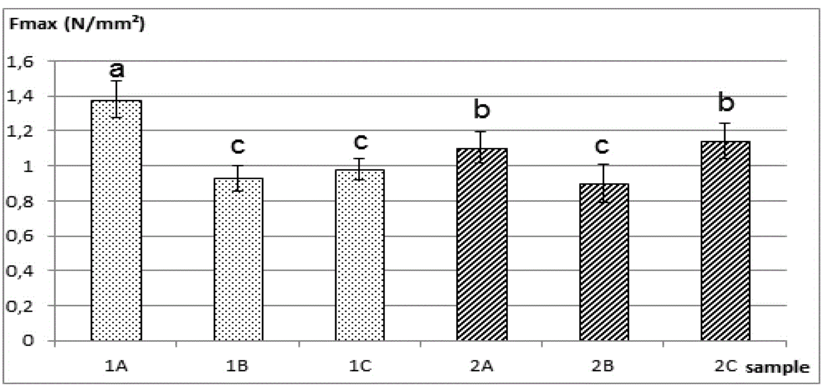
It is noteworthy that in case of a product with different granule sizes this approximation is not applicable. Further methodological problem arises if the granule surface is remarkably curved causing a so-called "two-step" structural degradation of the sample.

Compression measurement

During the course of methodological experiments the optimal sample volume was determined based on the maximum force value needs for the 80 percentage compression. According to our preliminary results 25 cm³ of sample volume proved to be adequate for the further measurements. It should be mentioned that particle size and shape have remarkable effects on the extent of compression. However in the present study this effect was negligible due to the similarity in size and shape of the examined samples.

Figure 2

Results of the compression measurement



Where: 1-premium, 2-good; A-chicken, B-lamb, C-tuna

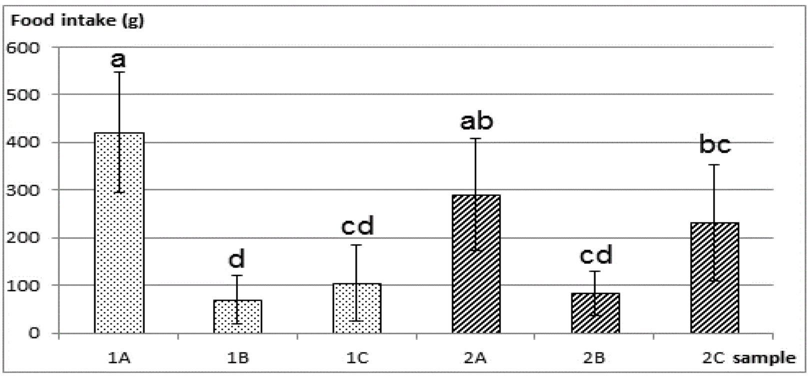
According the compression results the 1A samples proved to be the hardest among the six examined samples similarly to the results of the individual breaking measurement (*Figure 2*). There were statistically proven differences between the compression values of the samples. Based on the lower standard deviation values of the compression measurements this method seems to be more reliable than individual breaking. It should be noted that the different granule shapes and sizes effect the compression rate which modify the results remarkably.

Preference test

The average feed consumption values were remarkably different between the sample-groups with similar feed composition. The difference within the most and least preferred cat foods were more than five-fold in food intake (*Figure 3*). On the other hand it is obvious that the taste characteristics have a significant effect on the preference order, too.

Figure 3

Average feed consumption



Where: 1-premium, 2-good; A-chicken, B-lamb, C-tuna

According the results the hardest 1A product proved to be the most favorable cat food. Interestingly the order of the compression force needed (*Figure 2*) is similar to the feed intake order of the different cat food products. Finally a strong correlation ($r = 0.97$) was obtained between these structural and preference data.

CONCLUSIONS

The structure analyzer device development was successful. From methodological point of view the compression equipment was useful in structural characterization of the dry pet food samples in a stable and reproducible manner. Using the method, remarkable structural variations were described within the food samples with different composition provided by different producers.

The hardness of the dry cat food granules has a substantial effect on their preference. Regarding to the composition and structure interactions further examinations are needed to describe the interrelations in detail.

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