SOME ENGINEERING PROPERTIES OF DIFFERENT FEED PELLETS

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ABSTRACT

Due to lack of information about the physical and mechanical properties of feed pellets which are very important to understand the behavior of the product during the processing operations such as transporting, packaging and storage processes and also, it is necessary in processing operations. The main objective of this work was to study the physical and mechanical properties to form an important database for four of the most popular feed pellets in Egypt. These properties include: linear dimensions, mean diameter, surface area, volume, mass, density, static friction coefficient, repose angle and crushing load.

The engineering parameters results showed that the length and mean diameters were in the range of 0.50-2.44 and 0.40-1.24 cm for all pellet sizes with CV of 12-33 and 2-3 %. Feed pellet types in all sizes were cylindrical in shape. The surface areas ranged from 0.86-11.95 cm^2 and the feed pellet mass ranged from 0.07-3.01 g depending on the feed pellet size. The volume ranged from 0.06-2.96 cm^3 with CV of 11-31%, the bulk density ranged from 0.64-0.74 g/cm^3 with CV of 23-36% and real density ranged from 1.02-1.15 g/cm^3 with CV of 9-14% for all feeds. The repose angle ranged from 25.67-38.7°. The coefficient of static friction (C.S.F) ranged from 0.48-0.80 for all sizes and surfaces. The highest C.S.F was offered by concrete surface followed by the plywood and the galvanized steel surfaces. Crushing load increased with the pellet size ranged from 90.74 to 454.13 and from 29.5 to 348.35 N in vertical and horizontal position, respectively, depending on the feed pellet size.

Keywords: *Feed pellets; Physical; Mechanical; Properties; Repose angle; Crushing load; Friction coefficient.*

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INTRODUCTION

The physical and mechanical properties of feed pellets are not the first thought in the mind of dairy producers, cattlemen, or feed professionals as they plan feed rations. It does however have an impact in the decisions that need to be made when planning and designing the on farm feed storage. The discussion of some physical and mechanical properties of feed pellets should help the farmer or feed professional recognize the important considerations such as volume of storage required and handling options and transporting that need to be addressed in planning for storage (Kammel, 1991).

Different processes occurring during harvest and manufacturing of a product will impact the properties of the end product or by-product used as animal feed. Feed pelleting consists of a series of unit operations, including grinding, mixing, conditioning with moisture, addition of heat of both thermal and mechanical origin, expander treatment, pelleting and subsequent cooling of the product (Thomas et al., 1997). Technical pellet quality is controlled by the operations at the feed mill, but also by the raw material quality and addition of binders (Aarseth and Prestlokken, 2003; Thomas et al., 1999).

Studies regarding the physical characteristics of the feed pellets involved in seawater (Findlay & Watling, 1994; Chen et al., 1999a) and freshwater (Elberizon and Kelly, 1998) fish farming sand systems have been previously published but there is a complete lack of information regarding the characteristics of the feed employed in the rearing of Mediterranean species.

Optimization of feed processing requires methods to measure the mechanical properties and the technical quality of the feed. The Holmen durability test and the Kahl hardness test are frequently used for this purpose (Payne et al., 1994; Thomas and van der Poel, 1996). Knowledge of technical pellet quality is also important relative to transportation and handling of the product. It is known that pellets can be damaged during transportation (Fasina and Sokhansanj, 1996), but it is desirable that the product retains its structure during handling and conveying, until eaten by the animal (Behnke, 1996).

Due to the lack of information about the physical and mechanical properties of feed pellets which are very important to understand the behavior of the product during processing, transporting, packaging and storage processes operations, the main objective of this work was to study the physical and mechanical properties to form an important database for four of the most popular feed pellets in Egypt (large animal, rabbit, poultry growing and finishing feed pellets). These properties include: linear dimensions, mean diameter, surface area, volume, mass, bulk and real density, static friction coefficient, repose angle, and crushing load.

EXPERIMENTAL PROCEDURES

Four feed pellet recipes were produced at the feed processing unit, the Agricultural Engineering Department, Faculty of Agriculture, Moshtohor, Benha University. The feed processing unit includes: milling unit, weighing unit, mixing unit and pelletizing unit. The feed ingredients of these recipes are shown in table (1) and Fig. (1). Those categories were used to measure the linear dimensions, mass, volume, bulk density, angle of repose, static friction and crushing load.

Table (1): Feed ingredients of four feed pellet recipes.

Ingredients	Large animal feed	Rabbit feed	Grower poultry feed	Finisher poultry feed
Yellow corn (9% protein), %	40	13	65	65
Soybean meal (44% protein), %	10	24	25	10
Hay (15% protein), %	-	21	-	-
Wheat bran (11% protein), %	40	19	-	10
Barley (10% protein), %	-	23	-	-
Cotton seed meal (41% protein), %	10	-	-	-
Concentrate, %	-	-	10	10

الملخص العربى

بعض الخصائص الهندسية لمصبعات الاعلاف المختلفة

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نظرا لعدم وجود معلومات كافية عن الخواص الطبيعية والميكانيكية للأعلاف التي هي غاية فى الأهمية لفهم سلوك المنتج خلال عمليات التعبئة والتغليف والنقل وعمليات التخزين وأيضا ضروريه في عمليات التجهيز والعمليات الحرارية المختلفة أثناء التصنيع، لذا كان الهدف من هذا البحث هو دراسة بعض الخصائص الطبيعية والميكانيكية لإنشاء قاعدة بيانات لأربعة أنواع من الأعلاف (مصبعات) الأكثر شيوعا فى مصر (علف ماشية حلابة، علف دواجن نامى ، علف دواجن ناهى، علف أرانب) . وتشمل هذه الخصائص : الأبعاد الخطية، المساحة السطحية، الأقطار، الحجم والكتلة والكثافة، معامل الاحتكاك ، زاوية التكويم و قوة السحق.

وكانت أهم النتائج المتحصل عليها أن المتوسط العام للأطوال والأقطار الهندسية تراوح ما بين 0.50- 2.44 و 0.40- 1.24 سم على التوالي حسب الفئات المختلفة تحت الدراسة بمعامل اختلاف 12-33 % و 2-3 %. جميع انواع المصبعات تأخذ الشكل الاسطوانى من حيث الشكل، وتراوحت المساحة السطحية بين 0.86-11.95 سم^2 فى حين تراوح متوسط الاوزان 0.07-3.01 جم حيث تعتمد على حجم المصبعات. تراوح المتوسط العام للحجم بين 0.06 -2.96 سم^3 بمعامل اختلاف 11-31%، للكثافة الظاهرية 0.64-0.74 جم/سم^3 والكثافة الحقيقية 1.02-1.15 جم/سم^{3}و زاوية التكويم 25.67-38.7 درجة. بلغ المتوسط العام لمعامل الاحتكاك 0.48-0.80 لجميع الفئات على الاسطح المختلفة. سجلت أعلى قيم لمعامل الاحتكاك على الاسطح الخرسانية يليها الاسطح الخشبية وسجلت اسطح الصلب المجلفن أقل قيمة لمعامل الاحتكاك. يزداد حمل السحق زيادة طردية مع زيادة الحجم، وتراوح حمل السحق بين 90.74-454.12 نيوتن على الوضع الرأسى و 29.5-348.35 نيوتن على الوضع الافقى مع اختلاف الحجم.

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