SLOVENSKI STANDARD
oSIST prEN 16967:2016

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Krma: Metode vzorčenja in analize - Napovedne enačbe za presnovno energijo v popolni in dopolnilni mešanici hrane za hišne živali za mačke in pse (vključno z dietično hrano)

Animal feeding stuffs: Methods of sampling and analysis - Predictive equations for metabolizable energy in complete and complementary pet food for cats and dogs (including dietic food)

Futtermittel - Probenahme- und Untersuchungsverfahren - Vorhersagegleichungen für verstoffwechselbare Energie in vollständigem oder ergänzendem Tierfutter für Katzen und Hunde (einschließlich diätetisches Futter)

Aliments pour animaux - Méthodes d'échantillonnage et d'analyse - Équations prédictives de l’énergie métabolisable dans les aliments complets et les compléments alimentaires pour chats et chiens (y compris les aliments diététiques)

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Animal feeding stuffs: Methods of sampling and analysis - Predictive equations for metabolizable energy in complete and complementary pet food for cats and dogs (including dietic food)

Bestimmung des Energiewerts in Heimtierfutter

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 16967:2016) has been prepared by Technical Committee CEN/TC 327 “Animal feeding stuffs - Methods of sampling and analysis”, the secretariat of which is held by NEN.

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This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

Introduction

Balanced nutrition enabling adequate intake of energy, protein, minerals and vitamins is essential for cats and dogs to allow health and longevity. In order to realize the recommended intake of energy and nutrients, products need to be formulated accordingly. In other words: all essential nutrients need to be provided in the amount of diet which is needed to fulfil the daily energy requirements. The approach to provide nutrient recommendations expressed as units per MJ recognizes the close relationship between energy and nutrient intake. Hence the accurate determination of energy content in pet food is crucial for formulating appropriate diets for cats and dogs as well as the corresponding instructions for proper use.

Feeding trials are the most accurate way to measure the energy density of a pet food. Since animal studies are labour and cost intensive, several predictive equations for calculating metabolizable energy (ME) content in dog and cat foods have been developed during the years. The use of predictive equations is a well-established method within control authorities in Member States and within the pet food industry. However, there is currently no uniformity as to their use. Considering the labelling declarations required for certain pet food products listed in Annex I to Directive 2008/38/EC it is clear that there is a need for a harmonization at EU level by means of a European Standard laying down the predictive equations to be used.

The predictive equations in this standard will constitute simple tools to be used by control authorities and manufacturers to calculate ME by using values of dietary components determined by validated official methods (Regulation (EC) No 152/2009). This represents a good and robust compromise between accuracy and practicability to overcome the difficulties of feeding trials, which would be otherwise required to obtain the most accurate value of ME.

1 Scope

This draft European Standard defines predictive equations for the determination of ME in:

— products of vegetable or animal origin, in their natural state, fresh or preserved, such as meat, offal, milk products, cooked starch sources; highly digestible special products such as milk substitutes or diets for enteral nutrition;

— complete or complementary products derived from the industrial processing for cats and dogs.

2 Normative references

Not applicable.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
digestible energy
DE
gross energy of feedstuff minus the gross energy lost in faeces

Note 1 to entry DE provides an estimate of the energy the animal is able to use.

Note 2 to entry DE does not take into account energy losses via urine (and combustible gases).

3.2
gross energy
GE
total chemical energy arising from complete combustion of a food in a bomb calorimeter

Note 1 to entry The heat of combustion in feedstuffs can be predicted from the chemical analysis using standard values for the nutrients. For pet foods appropriate GE estimates for crude fat, crude protein and carbohydrates (NFE plus crude fibre) are 39,3 kJ/g, 23,8 kJ/g and 17,1 kJ/g, respectively [1–3].

3.3
metabolizable energy
ME
energy available to an animal after correction of the DE for losses via urine and combustible gases

4 Principle

4.1 General

In animal experiments the difference between the GE intake with feedstuffs and the GE loss via faeces is used to determine the digestible energy of a food. For this, GE of food and faeces is determined by complete combustion in a bomb calorimeter. Alternatively, DE can be calculated by multiplication of GE with the percentage of apparent digestibility of energy divided by 100. Equations to estimate energy digestibility as a function of fibre have been based mainly on crude fibre (CF) analysis for practical reasons: crude fibre is mostly used in labelling the pet food and the methodology is well established with the added benefit of being cheap and easy to perform. Consequently, there is much more data on crude fibre and energy digestibility than on any other fibre analysis.

4.2 Gross energy (GE)

The gross energy (GE) content of a food is defined as the total chemical energy arising from complete combustion of a food in a bomb calorimeter. The heat of combustion in feedstuffs can be predicted from the chemical analysis using standard values for the nutrients. For pet foods appropriate GE estimates for crude fat, crude protein and carbohydrates (NFE plus crude fibre) are 39,3 kJ/g, 23,8 kJ/g and 17,1 kJ/g, respectively [1]-[3].

4.3 Digestible energy (DE)

In animal experiments the difference between the GE intake with feedstuffs and the GE loss via faeces is used to determine the digestible energy of a food. For this, GE of food and faeces is determined by complete combustion in a bomb calorimeter. Alternatively, DE can be calculated by multiplication of GE with the percentage of apparent digestibility of energy divided by 100. Equations to estimate energy digestibility as a function of fibre have been based mainly on crude fibre (CF) analysis for practical reasons: crude fibre is mostly used in labelling the pet food and the methodology is well established with the added benefit of being cheap and easy to perform. Consequently, there is much more data on crude fibre and energy digestibility than on any other fibre analysis.

4.4 Metabolizable energy (ME)

The ME of a food is determined by subtracting energy losses via urine from the DE. In species with relevant extent of fermentation activity such as ruminants, energy losses through combustible gases are subtracted from the DE as well. Fermentation losses by gas can be neglected in dogs and cats, therefore only the separate collection of faeces and urine is required in digestion trials. In order to avoid the use of metabolic cages it is common practise to collect only faeces and to correct for energy losses via urine using a fixed value for urinary GE losses per g digested protein multiplied by the amount of digestible protein in the food. Therefore, 5,2 kJ/g digestible protein is subtracted for dogs and 3,6 kJ/g digestible protein for cats applying either the apparent protein digestibility measured in a digestion trial or a mean apparent protein digestibility of 83,5 % in dogs and 86 % in cats.

4.5 Mathematical prediction of metabolizable energy (ME) in food for cats and dogs

The predictive equations of ME are based on the results of feeding trials. Calculation of ME in accordance to these equations employ contents of dietary components, determined by validated official methods (Regulation (EC) No 152/2009). The mathematical prediction of metabolizable energy (ME) in food for cats and dogs can be described in four steps:

1) estimation of gross energy (GE) using appropriate GE estimates for crude fat, crude protein and carbohydrate (with crude fibre);

2) estimation of the percentage apparent energy digestibility using a linear regression equation based on crude fibre content per dry matter;

3) calculation of digestible energy (DE) (GE × aD GE/100);

4) conversion into ME by subtracting urinary energy losses related to protein metabolism.

4.6 Conversion factors

Conversion factors Kcal conversion to kJ: 1 kcal = 1 000 cal = 4,184 kJ; 1 MJ = 1 000 kJ = 239 kcal.

4.7 Nitrogen-free extract (NFE)

NFE comprises the carbohydrate fraction including starch, simple sugars and soluble parts of cellulose, hemicellulose, lignin and pectin. NFE is calculated according to Formula (1):

NFE = 100 - (% moisture + % crude protein + % crude fat + % crude ash + % crude fibre) (1)

where

NFE = nitrogen free extract, in %.

5 Reagents and materials

All the reagents shall be of analytical grade.

All reagents used for determination of moisture, protein, fat, ash and fibre as described under Clause 9, "Measurements".

6 Apparatus

Usual laboratory equipment and, in particular, those for determining moisture, protein, fat, ash and fibre.

7 Sampling

It is important that the laboratory receives a sample that is homogenous and truly representative and has not been altered or changed during transport and storage.

Sampling is not part of the method specified in this European Standard. A recommended sampling method for feed is given in Regulation (EC) No 152/2009 Annex I or equivalent.

8 Sample preparation

A recommended sampling method is given in Regulation (EC) No 152/2009 Annex II point A or equivalent.

9 Measurements

9.1 Moisture.

NOTE Regulation (EC) No 152/2009 Annex III, method A is applicable.

9.2 Protein (crude).

NOTE Regulation (EC) No 152/2009 Annex III, method C is applicable.

9.3 Fat (crude).

NOTE Regulation (EC) No 152/2009 Annex III, method H, Procedure B, with Hydrolysis compulsory for pet food (7.3) is applicable.

9.4 Ash (crude).

NOTE Regulation (EC) No 152/2009 Annex III, method M is applicable.

9.5 Fibre (crude).

NOTE Regulation (EC) No 152/2009 Annex III, method I is applicable.

10 Determination of energy by calculation

10.1 Natural state

The metabolizable energy (ME) in products of vegetable or animal origin, in their natural state, fresh or preserved, such as meat, offal, milk products, cooked starch sources; highly digestible special products such as milk substitutes or diets for enteral nutrition can be predicted with Formula (2a) for dog food and Formula (2b) for cat food.

$$ME(dogs) = (0{,}016\ 74 \times g/kg\ crude\ protein) + (0{,}037\ 67 \times g/kg\ crude\ fat) + (0{,}016\ 74 \times g/kg\ NFE) \quad (2a)$$

$$ME(cats) = (0{,}016\ 74 \times g/kg\ crude\ protein) + (0{,}035\ 57 \times g/kg\ crude\ fat) + (0{,}016\ 74 \times g/kg\ NFE) \quad (2b)$$

where

ME = Metabolizable energy, in MJ/kg.

10.2 Industrial state

The metabolizable energy (ME) in complete or complementary products for dogs and cats derived from the industrial processing van be predicted with the following steps and Formulae (3) to (6).

1) Calculate GE with Formula (3) for both dog and cat foods.

$$GE = (0{,}02385 \times g/kg\ crude\ protein) + (0{,}03933 \times g/kg\ crude\ fat) + [0{,}01715 \times (g/kg\ NFE + g/kg\ crude\ fibre)] \quad (3)$$

where

GE = Gross energy, in MJ/kg.

2) Calculate the apparent digestibility of gross energy with Formula (4a) for dog food and Formula (4b) for cat food.

$$\%\ energy\ digestibility\ (dogs) = 91{,}2 - (1{,}43 \times \%\ crude\ fibre\ in\ dry\ matter) \quad (4a)$$

$$\%\ energy\ digestibility\ (cats) = 87{,}9 - (0{,}88 \times \%\ crude\ fibre\ in\ dry\ matter) \quad (4b)$$

3) Calculate the digestible energy with Formula (5).

$$DE = (GE \times digestibility\ of\ GE\ (\%)) / 100 \quad (5)$$

where

DE = digestible energy, in MJ/kg;

GE = gross energy, in MJ/kg.

4) Convert into metabolizable energy with Formula (6a) for dog food and equaition (6b) for cat food.

$$ME(dogs) = DE - (0{,}004\ 34 \times g/kg\ crude\ protein) \quad (6a)$$

$$ME(cats) = DE - (0{,}003\ 22 \times g/kg\ crude\ protein) \quad (6b)$$

where

ME = metabolizable energy, in MJ/kg;

DE = gross energy, in MJ/kg.

10.3 Examples

10.3.1 Dog food

Composition of the pet food:

— 80 % moisture

— 7 % crude protein

— 4 % crude fat

— 3 % crude ash

— 1 % crude fibre

— 5 % NFE

Calculation of the ME:

Step 1, Formula (3): GE = (0,023 85 × 70) + (0,039 33 × 40) + [0,017 15 × (50 + 10)] = 4,27 MJ/kg

Step 2, Formula (4a): Percentage energy digestibility = 91,2 - (0,143 × 50) = 84,05 %

Step 3, Formula (5): DE = 4,27 × 84,05/100 = 3,59 MJ/kg

Step 4, Formula (6a): ME = 3,59 – (0,004 34 × 70) = 3,28 MJ/kg

10.3.2 Cat food

Composition of the pet food:

— 80 % moisture

— 7 % crude protein

— 4 % crude fat

— 3 % crude ash

— 1 % crude fibre

— 5 % NFE

Calculation of the ME:

Step 1, Formula (3): GE = (0,023 85 × 70) + (0,039 33 × 40) + (0,01715 × (50 + 10)) = 4,27 MJ/kg

Step 2, Formula (4b): Percentage energy digestibility = 87,9 - (0,088 × 50) = 83,5 %

Step 3, Formula (5): DE (MJ/kg) = 4,27 × 83,5/100 = 3,57 MJ/kg

Step 4, Formula (6b): ME (MJ/kg) = 3,57 – (0,003 22 × 70) = 3,34 MJ/kg

11 Accuracy

Recent reviews [4-6] comparing the accuracy between the modified Atwater method and the equations cited by NRC (2006; [7]) versus measured ME have shown the following: