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Feed Value of Germinated Barley for Waterfowl

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1 Introduction

In eariler literature the use of germinated grain was recommended for the feeding of poultry. A positive effect was confirmed by a great many authors, especially for germinated oat (MAIER, 1919; DÜRINGEN, 1922; WEINMILLER u. VOIGT, 1933; GRZIMEK, 1937). The most important effects were a better supply of vitamins, a increase in laying performance and more intensive growth of feathers. But, as a matter of fact, no systematic experiments for determining the feed value of germinated grains are available.

During the biochemical process of germination, negative influences on the feed value are possible, because the synthesis and degradation of nutrients and there transport in the germ and root (LAMPETER, 1988). Additional effects of germination are the lower content on soluble ß-glucane (SVIHUS et.al., 1997) in barley, activation of plant own enzymes as Phytase (OLOFFS, 1998) and enrichment of some amino acids by protein hydrolysis (SVIHUS, 1997). A consequence of this literature review was to create experiments with the aim of estimating the feed value of germinated barley for adult Peking ducks and geese and to compare the results of this experiments with knowledge of feed value tables and literature about the feed value of grain for waterfowl. Contrary to former trials, where the germination was done in the traditional way, a germination machine was used. It's possible that this equipment has additional effects on the feed value of the germinated grain, because the process of germination includes a washing procedure. It is possible that this not only reduces the nutrients in the feed but that it also has a hygienic effect (washes out toxic substances).

2 Material and Methods

Implementation of experiment

Barley of the variety "Grete" was germinated in a germination machine, which was produced by "Agroanlagenbau Dresden GmbH". This machine consisted of 8 germination reservoirs each with a capacity of 25 kg of grain, a water supply, and blower with heating and control equipment to regulate the passage of water and air. The germination

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process took 48 hours altogether and achieved in the following way:. after the filling of the germination reservoirs with grain cold water was added until the grain was covered with water. Then cold air was blown through the grain. The result was a whirlpool with a washing effect. This part of the process was completed after 2 hours by closing the air supply and increasing the water-level until it overflowed. The water was allowed to overflow for 20 minutes and was intended as a cleaning process by removing fine particles, as well as earth and chaff, from the grain.After this, air at 24°C was blown through the grain for 4 hours.

After this period the air supply was stopped, the grain in the reservoir was covered again with water and left for 20 minutes. The next step was to extract the water again and to supply air again for 4 hours. This cycle was repeated until the 48 hours was up. After the germination process the germ had a size of 2-3 mm and the roots were 1-2 cm.

The germinated barley was stored in a freezer at - 18 °C for 12 hours before being fed to the birds. This technique ensured that the quality of the barley during the trial period and provided a security against microbial ruin.

The trials were designed to determine the total amount of digestable crude protein and organic matter and to determine the content of metabolizable energy. The trials were carried out with 6 adult, one year old gander (hybrid based on the German laying goose) and 6 adult, one year old Peking drakes (source Altfriedland). The average live weight of ganders was 6,09 kg and of drakes 4,41 kg. The birds were reared in special single cages for waterfowl with an area of 0.4 m^2 per bird. The food and water troughs were placed on different sides of the cages in order to reduce the amount of food washed from the beaks. The digestibility experiments were divided in a pre-period and a collecting period of 5 days each. During the pre-period the germinated barley was fed twice daily with a measured amount of food. For the ganders the amount of feed was 300 g per bird per meal and for drakes 200 g per bird every meal. The tested grain was not supplemented with minerals, trace elements or vitamins. Also grit was not given. A collection of all excrement was done twice a day and leftover food and feathers were collected. Food from the drinker troughs was filtered, dried and weighed to estimate the dry matter loss. The excrement collected was frozen after each collection in a deep freezer. The digestibility experiments were based on the principles of Schiemann (1981).

Sample management and analysis

The standard methods of VDLUFA (Association of German agricultural analysis and research institution) were used for analysis of nutrients (Naumann and Bassler, 1993). Under deep frozen conditions the stored excrement was dried by a freeze-drying method, followed by grinding to a 1 mm particle size. Samples were stored in hermetical sealed bottles before analysis. The apparent digestibility of crude protein was estimated with a-amino-N-analysis of germinated barley and excrements according to the method described by Pahle et.al. (1983/85). The apparent nitrogen corrected metabolizable energy (AME_N) was determined by estimating nitrogen and cross energy levels in food and excrements (estimation of caloric value with isoperibol bomb calorimeter IKA C 7000). The metabolizable energy was corrected on a nitrogen balance of zero with the factor 36.5 kJ/g N-Bilance (Titus et. al., 1959).

Statistical analysis

Statistical analysis was carry out using Statistica for Windows™ (StatSoft INC., 1994). For comparison of means between both kinds of poultry, the t-test was used.

3 Results

The composition of whole barley and germinated barley is shown in Table 1.

Table 1: Nutrient composition of the germinated barley (g/kg dry matter)

barley	dry matter	crude ash	crude fat	crude protein	crude fibre	starch	N-free extracts
whole	880	26	26	110	56	620	778
germinated	587	26	31	122	60	499	721

The comparison of crude nutrient content between whole barley and germinated barley shows that the content of crude protein, crude fat and crude fibre increased, but the content of starch and N-free extracts decreased. This effect is caused by the partial conversion of starch to sugar. This sugars are well soluble and were transported out of the grain during the washing process. The result is a higher proportion of all the other nutrients.

Table 2: Apparent digestibility of crude protein (%), organic matter (%) and content on N-corrected apparent metabolizable energy (MJ AME_N/kg dry matter)

	organic matter		Crude protein		AME_N	
	M[1]	± s[2]	M	± s	M	± s
drakes	69.3 a	1.3	87.0 a	0.8	12.41	0.38
gander	73.3 b	2.6	89.1 b	1.1	12.35	0.28

[1] mean; [2] standard deviation

4 Discussion

The results of this digestibility experiment shows that geese have a better ability to digest crude protein and organic matter in comparison to Peking ducks. But no differences were found for the content of metabolizable energy (AME_N). This result may be caused by the digestibility of crude carbohydrate fraction, which was not estimated in this experiment.

The mean for metabolizable energy (AME_N) of germinated grain (geese and ducks) of 12.38 MJ/kg is lower than the table value for whole barley (12.76 MJ/kg). This comparison is not very useful because the table values are chicken-related parameters and not really applicable for waterfowl. On the other hand, the difference of 0.4 MJ/kg is clear and leads to the conclusion that the feed value of germinated barley is lower than for whole barley and that the germination process decreases the feed quality.

In comparison to other waterfowl-related values the same conclusion can also be drawn, because estimated values in the present work are lower than values found by other authors (Table 3).

Table 3: AME_N values and digestibility of organic matter (OM) for different feeds tested on waterfowl

Feed	KING et.al. (1997) AME_N (MJ/kg)	MAUREEN (1982) AME_N (MJ/kg)	chicken-related values AME_N (MJ/kg)	NEHRING et.al. (1965) digestibility of OM (%)	SCHUBERT et. al. (1982) digestibility of OM (%)
wheat	14,74	15,73	14,26	78	89
barley	--	15,58	12,76	75	--
rye	12,62	12,87	12,60	76	--
oat	16,33	15,55	15,13	--	--
corn	14,87	18,85	15,29	--	--
rice	16,20	--	12,02	--	--

It seems that waterfowl has a higher ability to convert the energy from the feedstuffs than chicken, because King et.al. (1997) and Maureen (1982) found higher AME_N values for waterfowl. There is further evidence for the thesis that germination decreases the feed quality because lower values then the chicken-based values were found.

5 Summary

Whole barley was germinated in a germination machine for 48 hours and tested in a balanced test with adult gander and Peking drakes. The germination effected changes in the composition of crude nutrients of the barley. The most important changes were a lower content of starch and higher proportions of crude protein, crude fat and crude fibre. The investigation included estimation of the apparent digestibility of crude protein and organic matter and an estimation of the content of apparent nitrogen corrected metabolizable energy. The digestibility parameters were better for geese but these small differences did not effect the content of metabolizable energy. For geese and ducks, germinated barley has the same feed value. Loss of starch caused by the germination process effected the lower content of metabolizable energy (0.4 MJ/kg) in comparison to the chicken-related values for whole barley.

Der Futterwert gekeimter Gerste für Wassergeflügel

Zusammenfassung

Gerstenkörner wurden 48 Stunden lang in einem Keimapparat angekeimt und anschließend in einem Verdauungsversuch an ausgewachsenen Gantern und Peking-Erpeln geprüft. Die Keimung rief Veränderungen in der Rohnährstoffzusammensetzung der Gerste hervor. Die wesentlichsten Veränderungen waren ein verminderter Stärkegehalt und höhere Gehalte an Rohprotein, Rohfett und Rohfaser. Die Untersuchungen schlossen die Bestimmung der Verdaulichkeit der organischen Substanz und des Rohproteins, sowie die Ermittlung der N-korrigierten Umsetzbaren Energie ein.

Die Gänse wiesen zwar etwas bessere Verdaulichkeitsparameter auf, aber diese geringen Unterschiede spiegelten sich nicht im AME_N-Gehalt wieder. Somit hat gekeimte Gerste für Enten und Gänse den gleichen Futterwert von 12,38 MJ/kg TS. Die Stärkeverluste während der Keimung sind die Ursache für den geringeren Gehalt der gekeimten Gerste an umsetzbarer Energie (0,4 MJ/kg TS) im Vergleich zu dem an adulten Hühnern ermittelten Wert für ganze Gerstenkörner.

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