POTENTIAL OF NATIVE ORGANIC FEEDING STUFFS IN POULTRY PRODUCTION

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Abstract. Supply of organic broilers with methionine in the starter period is difficult due to legislation. This results in a methionine gap which has to be filled. Normally, protein feeding stuffs also provide distinct amounts of methionine, whereas, bulk feeding stuffs like cereals have a low methionine content. The present project aimed to determining the content and the digestibility of amino acids of 15 bulk feeding stuffs which may be used in organic broiler production. In an animal experiment with slow growing broilers the ileal digestibility of amino acids was determined in the third and sixth week of life. Most of tested organic feeding stuffs contained less main nutrients and amino acids than the same feeding stuffs from conventional production. Amino acids digestibility was lower for feeding stuffs with high contents crude fibre and did not differ between the third and sixth week of life. The content of methionine related to the total crude protein content was similar in organic and conventional feeding stuffs. The methionine contribution of bulk organic feeding stuffs to the requirements of the birds was less than for conventional ones. Anyway, results increased the information on the nutrient contents of less common organic feeding stuffs.

Keywords: Poultry, nutrition, native feeding stuffs, nutrient value

Introduction

Poultry has rather high requirements for crude protein and/or amino acids. Especially, methionine requirements are such high that they cannot be fulfilled by the use of protein feeding stuffs alone. Thus, the supply gap is filled with free methionine. Anyway, feed manufacturers are interested to have a good basic supply with crude protein and/or methionine and lysine and thus they use high protein feeding stuffs like solvent extracted soybean meal (SES). SES is characterized by high contents of crude protein (540 g/kg DM), methionine (7.3 g/kg DM) and lysine (33.1 g/kg DM) and low content of crude fibre (39 g/kg DM) (Jeroch et al., 2008). Digestibility of amino acids is high in general, standardized ileal digestibility for poultry is estimated for lysine and methionine as 90 and 91 %, respectively (AMINODat® 4.0). This renders SES as a very good feeding stuff for poultry. According to Directive (EG) No 834/2007 SES is not allowed to be used in organic animal nutrition. Alternatives may be animal/meat and bone meal (currently prohibited in the European Union), fish meal (variable nutrient content with the risk of sensory disturbance of products) and industrial by-products like gluten of corn, wheat, rice etc. As native protein feeding stuffs seeds of legumes, flax, rape, sunflower etc. are used. The main disadvantage of these native feeding stuffs is the partly high content of anti-nutritive ingredients like fibre fractions, tannin, sinapin and glucosinolates which belong to the defence system of the plants. Besides, most native feeding stuffs have only a moderate protein content with low contents of methionine and moderate digestibility, in general. This complicates the designing of diets fulfilling nutrient requirements of poultry, especially in organic production. Up to now it is hard to formulate diets for meat-type chicken or turkey which can fulfil methionine requirements in the first 3 weeks of life. This problem is augmented by the fact that 'bulk' feeding stuffs (mainly energy feeding stuffs) with low protein and methionine contents comprise the biggest portion of the compound feed. Therefore, a project was started to evaluating the contribution of 'bulk' feeding stuffs (mainly cereals) to the methionine supply in broiler starter feed.

Materials and Methods

In cooperation with the organization Naturland 15 feeding stuffs of interest have been identified for the study. In a first step, the feeding stuffs have been analysed for contents of main nutrients and amino acids and in a second step ileal amino acids digestibility has been determined in three and six weeks old ISA JA 957 broilers of mixed gender according to Rodehutscord et al. (2004). The experiments were conducted considering the Directive 2010/63/EU and were approved by local authorities (RP Tü 1/12 HOH).

Day-old broiler chicks were reared in a broiler house with controlled environment and were assigned to treatment groups on day 15 (15 birds/group) and 36 (6 birds/group), respectively. Each treatment comprised 6 replicates.

The following feeding stuffs have been tested: wheat (WW), barley (SG), naked barley (NG), rye (WR), naked oats (NH), triticale (WT), buckwheat (BW), spelt (DI), pearl millet (RH), brown millet (BH), lentils (LA), whole corn silage (GKS), untreated lucerne silage (KU), extruded lucerne silage (KB), dried lucerne leaves (LB). KU and KB have been provided by University of Applied Sciences Weihenstephan-Triesdorf (Germany) and LB by University of Kassel (Germany).

According to the protocol for determining ileal digestibility of amino acids (Rodehutscord et al., 2004) the test feeding stuff is supplemented to the basic diets (consisting mainly of full-fat soybeans, wheat bran, corn starch and Titanium dioxide as an inert marker) by 30, 50 and 70 %, in exchange of corn starch. Thus, the diet with 30 % test feeding stuff contains 40 % corn starch and is supplemented with methionine, lysine and threonine to meet the requirements of birds

for these amino acids, whereas, the diet with 70 % test feeding stuff does not contain any corn starch. With increasing portion of test feeding stuff contents of amino acids increase, as well.

Experimental design: 15 feeding stuffs x 3 supplementation levels x 2 broiler ages = 90 x 6 replicates = 540 groups of 15/g birds = 5670 broilers.

Birds were fed with experimental diets for one week from days 15 and/or 36 of life on. On days 21 and 42 of life, all birds were killed by carbon dioxide and the intestine was harvested. Two thirds of the section between Meckel's diverticulum and 2 cm before the junction of the caeca were separated, the chymus collected and pooled. Samples were frozen immediately and freeze dried before analysis.

Crude nutrient contents of feeding stuffs were determined according to Naumann and Bassler (1976) and contents of amino acids in feeding stuffs, final diets and chymus of birds according to Directive (EG) No 152/2009. Content of Titanium dioxide was determined by photometry.

Digestibility of amino acids was determined by regression analysis according to Rodehutscord et al. (2004).

Results

Lentils, lucerne silage (KU, KB) and lucerne leaves had the highest crude protein content followed by naked barley, naked oats and brown millet (Table 1). Crude protein content of rye was poor. The highest fibre contents were found for KB, KU, lucerne leaves, brown millet, buckwheat and spelt. There was also a big variation in the starch content. Lucerne leaves had a rather high Ca content, whereas, tested feeding stuffs did not vary greatly in their phosphorus content.

Table 1. **Analysed contents of main nutrients in test feeding stuffs (g/kg fresh matter)**

	DM	CP	Ash	Fibre	Sugar	Starch	Ca	P
Brown millet	888	143	45	101	6	579	1.7	4.0
Buckwheat	892	123	27	147	9	569	2.0	4.3
Spelt	884	122	39	122	20	485	1.8	4.2
GKS	884	100	14	29	1	683	1.6	3.1
KB	932	204	128	214	31	23	12.1	3.5
KU	921	218	123	210	31	23	12.1	3.7
Lentils	876	256	46	61	38	455	3.7	5.8
Lucerne leaves	892	201	132	202	38	45	20.0	3.1
Naked barley	870	158	20	19	32	625	1.3	4.6
Naked oats	878	139	22	32	13	591	1.9	4.8
Rye	866	72	19	26	100	644	1.8	3.6
Pearl millet	892	122	29	76	15	640	1.7	3.5
Barley	885	103	24	49	27	621	1.8	4.2
Triticale	881	92	21	28	33	718	1.7	4.0
Wheat	874	112	19	29	38	718	1.7	3.7
DM: dry matter, CP: crude protein, GKS: whole corn silage, KB: treated lucerne silage. KU: untreated lucerne silage								

For clarity, amino acids digestibility values are shown for the four first limiting amino acids and for three weeks old broilers, only. Digestibility of methionine was higher than 80 % for most feeding stuffs, the highest values (>90%) were determined for whole corn silage, lucerne leaves, naked oats, triticale and wheat (Table 2). A poor methionine digestibility was observed for spelt and lucerne silages (<61%). In a comparable way, digestibility of lysine, threonine and tryptophane were good in general, with poor values for spelt (lysine, threonine), lucerne silages and rye (threonine, tryptophane). Low digestibility values were accompanied by low coefficients of determination.

Comparison of calculated contents of digestible amino acids in feeding stuffs (Table 3) with expected requirements (methionine 4.0, lysine 10.6, threonine 6.9 and 1.6 g/kg fresh matter, respectively) revealed that the methionine content of all tested feeding stuffs was distinctly lower than these values. Only for brown millet, pearl millet and lucerne leaves the methionine content exceeded 2.0 g/kg dry matter. In the same way, the content of digestible lysine was much less than the underlying requirements. This holds also for threonine and tryptophane. The calculated contents of digestible threonine and tryptophane exceeded these values for lentils and lucerne leaves and for brown millet and lucerne leaves, respectively.

Discussion

Contents of main nutrients of tested organic feeding stuffs were partly significantly lower than those reported for conventional feeding stuffs (AMINODat® 4.0). The very low nutrient content of rye was surprising, especially, as this was seeding material. Nutrient contents of lucerne (both silages and leaves) and lentils have been about the same as of conventional varieties. Expressing the content of methionine in relation to the total crude protein content did not reveal distinct differences between organic and conventional (table values) feeding stuffs (Table 4). This indicates that it may be sufficient to determine the crude protein content of organic feeding stuffs and to calculate the approximate methionine content. The value has then to be corrected for digestibility.

Table 2. **Ileal digestibility (pcV) and coefficient of determination (R^2) of the 4 first limiting amino acids in 3 weeks old broilers (%)**

	Methionine		Lysine		Threonine		Tryptophane	
	pcV	R^2	pcV	R^2	pcV	R^2	Pcv	R^2
Brown millet	84	94	-	-	85	85	90	94
Buckwheat	85	97	78	92	68	87	71	95
Spelt	61	48	55	24	62	38	89	55
GKS	97	98	96	96	96	97	91	91
KB	37	21	24	24	35	64	34	64
KU	52	25	58	40	69	83	46	61
Lentils	89	97	88	99	81	98	72	93
Lucerne leaves	94	98	92	96	84	94	87	89
Naked barley	81	93	76	77	74	91	70	85
Naked oats	92	85	83	71	84	66	92	78
Rye	-	-	75	58	54	28	46	18
Pearl millet	77	83	-	-	79	83	82	94
Barley	87	94	75	77	74	83	78	90
Triticiale	99	98	99	94	98	93	99	98
Wheat	94	99	93	97	94	96	94	97
GKS: whole corn silage, KB: treated lucerne silage. KU: untreated lucerne silage								

Table 3. **Contents of the 4 first limiting amino acids in test feeding stuffs for 3 weeks old broilers (g/kg dry matter)**

	Methionine	Lysine	Threonine	Tryptophane
Brown millet	3.1	-	3.6	2.2
Buckwheat	1.8	5.5	3.1	1.1
Spelt	1.1	1.7	2.0	1.0
GKS	1.5	2.3	3.0	0.5
KB	1.1	2.5	3.1	0.8
KU	1.6	6.1	6.2	1.2
Lentils	1.6	14.1	7.2	1.4
Lucerne leaves	2.9	9.2	7.0	2.9
Naked barley	1.5	3.3	2.9	1.0
Naked oats	1.8	4.1	3.4	1.5
Rye	-	2.4	1.4	0.4
Pearl millet	2.2	-	2.7	1.2
Barley	1.5	3.1	2.6	0.9
Triciale	1.5	3.4	2.9	0.9
Wheat	1.6	3.1	3.0	1.0
GKS: whole corn silage, KB: treated lucerne silage. KU: untreated lucerne silage				

Table 4. **Content of methionine in relation to total crude protein (%)**

	Table values*	Analysed values
Brown millet	1.69	1.76
Buckwheat	2.30	1.71
Spelt	1.80	1.48
Lentils	0.85	0.70
Lucerne leaves	1.58	1.54
Pearl millet	2.13	2.37
Barley	1.59	1.64
Rye	1.58	1.53
Triticale	1.65	1.63
Wheat	1.48	1.52
* AMINODat® 4.0; Abdel-Aal und Hucl, 2002; DLG-Futterwerttabelle; Kalinova und Moudry, 2006; Zeller, 2001		

Digestibility values have been rather high for most amino acids and for most feeding stuffs. Anyway, there has been a big variation, although determined digestibility values have been in a comparable range to table values (AMINODat® 4.0). The low amino acids digestibility for the extruded lucerne silage may be caused by heat damage (Singh et al., 2007). In general, the high amino acids content of lucerne silages and buckwheat was counteracted by a low digestibility. This may be caused by the high crude fibre content (Jorgensen et al., 1996). In contrast, lucerne leaves showed a good amino acids digestibility despite the high fibre content, but animals did not grow efficiently. Obviously, here the high crude fibre content resulted in an increase in the feed volume limiting the total nutrient intake. Contrary to literature (Adedokun et al., 2007; Batal and Parsons, 2002) determined digestibility values were not really different for three and six weeks old broilers.

Conclusions

The results indicate that for organic feeding stuffs lower contents of digestible amino acids have to be considered, mainly due to lower absolute contents of amino acids. In contrast, amino acids digestibility of organic feeding stuffs does not differ significantly from conventional ones, but may be impaired by high contents of crude fibre. In general, tested bulk organic feeding stuffs contribute less to the methionine supply than conventional ones. This does not help to close the supply gap. Anyway, the main advantage of the study is that farmers have a more extended data base for composing their diets. For further improvement of the nutrient supply of organic broilers the real nutrients requirements of slow growing broilers have to be determined.

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