PROCEEDINGS OF THE 11th WORLD RABBIT CONGRESS
Qingdao (China) - June 15-18, 2016
ISSN 2308-1910

Session
Nutrition & Digestive Physiology

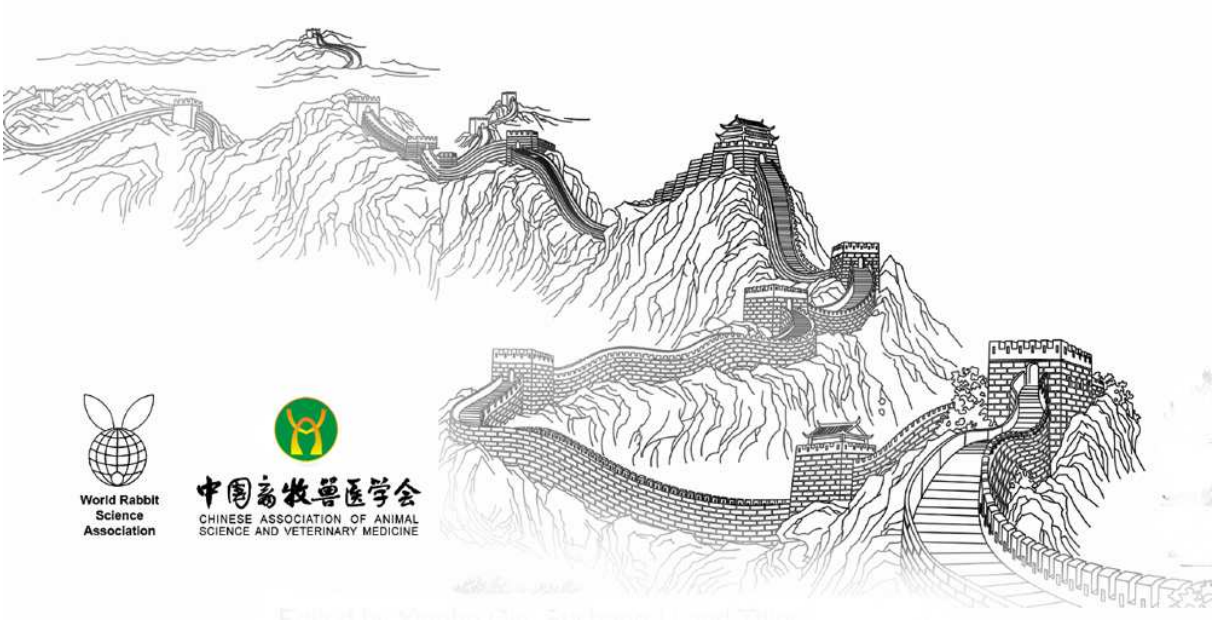
Lang C., Masthoff T., Spies M., Weirich C., Hoy St.

HOW DOES THE STRUCTURE OF FEEDSTUFFS INFLUENCE ETHOLOGICAL AND NUTRITIONAL PARAMETERS OF RABBITS.

Full text of the communication

How to cite this paper :
Lang C., Masthoff T., Spies M., Weirich C., Hoy St., 2016 - How does the structure of feedstuffs influence ethological and nutritional parameters of rabbits.. *Proceedings 11th World Rabbit Congress - June 15-18, 2016 - Qingdao - China, 289-292.*

.



HOW DOES THE STRUCTURE OF FEEDSTUFFS INFLUENCE ETHOLOGICAL AND NUTRITIONAL PARAMETERS OF RABBITS

Lang C.*, Masthoff T., Spies M., Weirich C., Hoy St.

Dept. of Animal Breeding and Genetics, Justus Liebig University, Leihgesterner Weg 52, 35392 Giessen, Germany
*Corresponding author: Caroline.Lang@agrar.uni-giessen.de

ABSTRACT

The direct influence of the feed structure (with otherwise identical feedstuffs) on rabbits was examined in the present study for different parameters. In three 1 m² flat decks with plastic slatted floor, two rabbits (hybrid, ♀, 12 - 16 weeks old, ø 3 kg body weight; 4 repetitions) were fed *ad libitum* exclusively with one of the following differently structured alfalfa types, respectively: 1. chopped, 2. pelleted, 3. grinded. In addition, water and a gnawing stick were provided *ad libitum.* The feed intake and the wear of the gnawing stick were documented. In a special observation box feed intake time for 0.1 g of each alfalfa variation were observed and video analysed for each rabbit. After 4 weeks rabbits were slaughtered and the following parameters determined: stomach weight and pH value of the stomach chyme, dry matter (DM) of stomach and caecal chyme and particle size of the stomach and caecal chyme by wet sieve analysis. A clear influence of the feed structure on the feed intake time, the wear of a gnawing stick as well as the state of the stomach chyme was proven in this investigation. Rabbits fed with chopped alfalfa hay showed a ($P<0.01$) lower dry matter content (13.9%) in caecal chyme, than those fed with grinded (17.5%) or pelleted alfalfa (20.0%). The feed intake time was up to 5 fold faster for pelleted feedstuff compared to the other groups. The gnawing stick was significantly stronger gnawed by animals fed with pelleted alfalfa than by animals of other feeding groups. Rabbits fed with chopped hay had a significantly higher percentage of the biggest structure sizes in stomach chyme (80.19% to 56.67% (pellets) and 54.34% (meal)) than the others, and a significantly lower percentage of the medium particle sizes (4.89% and 6.15% to 14.91% and 10.50% (pellets) and 11.89% and 17.75% (meal)) in caecal chyme.

Key words: Feed structure, feed intake time, gnawing stick, particle size, dry matter of caecal chyme.

INTRODUCTION

The structure of feedstuffs for rabbits can influence rabbit performance, behaviour and nutrition physiology (Gidenne, 1992, Gidenne, 1993, García *et al.*, 2000, Lebas, 2000, Dinges *et al.*, 2011, Greißl *et al.*, 2011, Lang *et al.*, 2011 a, b, Prebble *et al.*, 2015). Own investigations showed that rabbits fed with coarsely structured feedstuff like hay showed a significantly lower morbidity rate and also a lower mortality rate than rabbits fed with fine structured feedstuff like pellets. The feed intake duration in the course of the day was significantly longer for hay and rabbits needed significantly more masticatory movements and a longer time for uptake of 0.1 g of hay compared to pelleted feedstuffs. The pH value in stomach chyme was lower and villi of the small intestine (especially in duodenum) were significantly longer in rabbits fed with hay than in rabbits fed with pelleted feedstuffs. But also the daily weight gain and the final weight of the rabbits were significantly lower in rabbits fed with hay than in rabbits fed with pellets (Lang *et al.* 2016). However, attention should be paid to the fact that previous investigations were carried out with growing rabbits and the feedstuffs did not differ in particle size only. They also differed in additives and energy level. Wolf *et al.* (2007; 2010) showed that rabbit size

(dwarfs, New Zealand white and German Giants) had an influence on chewing activity and particle size in chyme and faeces. The authors concluded the higher proportion of finely grinded particles in chyme and faeces caused by a higher chewing activity led to a higher proportion of caecotrophe, and therefore to a higher digestibility of nutrients in dwarf rabbits compared to giants. The giants always had the lowest digestibility rate. The higher digestibility rates shown by dwarf rabbits may be the result of greater chewing intensity. Furthermore, the authors found a species specific effect and also a feeding effect on composition of the caecotrophe and the ratio of caecotrophe to the whole faeces. The purpose of this work was to analyse the direct influence of different structures of feedstuffs (with otherwise identically ingredients) on diverse parameters of ethology (feed intake behaviour, use of a gnawing stick) in adult rabbits. To underpin the effects of the influence of high and low structured feedstuffs on rabbit feed intake behaviour the particle size and dry matter contend in stomach and caecal chyme, the pH value and the weight of stomach chyme were measured.

MATERIALS AND METHODS

Animals and experimental design

Two rabbit does (hybrid, 12 - 16 weeks old, ø 3 kg of body weight, 4 repetitions) per cage were housed during 4 weeks, in 3 identical flat deck cages each (1 m² large, plastic slatted floor, elevated platform, 12 h light and darkness). They were fed *ad libitum* exclusively with one of three differently structured alfalfa types: 1. chopped (flat deck A), 2. pelleted (flat deck B), 3. grinded (flat deck C). Alfalfa was used because of the necessity to appropriate a homogenous feedstuff which can be structured in different sizes, not for possible nutritional benefits. The percentage of different particle sizes of pelleted and grinded alfalfa (table 1) were measured by wet sieve analyses (see "chemical analyses") or by use of a shaking box (chopped alfalfa).

Table 1: Percentage of particle sizes in feedstuffs (mm and cm)

Particle size (mm)[1]	Pellets (%)	Meal (%)	Hay chopped (%)
> 1	71.04	59.89	/
< 1.0 - > 0.5	18.38	17.17	/
< 0.5 - > 0.2	6.08	17.17	/
< 0.2	4.50	5.77	
Particle size (cm)[2]			
> 1.9	/	/	23.02
< 1.9 - > 0.8	/	/	11.11
< 0.8	/	/	65.87

[1]Measured by wet sieve analyses (mm); [2]measured with shaking box (cm)

Water and feed consumption were measured daily. In every flat deck a gnawing stick (apple tree) was added and weighed at the beginning of the trial. Also a reference stick was weighed in the beginning and at the end of each round to determine the natural dehydration losses. After 4 weeks of housing, gnawing sticks were reweighed to analyse the wear and tear (%) adjusted for natural dehydration losses. The feed intake time for rabbits fed the three differently feedstuff structures was measured on each rabbit in a special observation box. Rabbits were placed into the box and one of the three feedstuffs with different structures was given. The given portion of feedstuff was weighed and the amount not consumed reweighed. The time that rabbits needed for uptake the feedstuff was video-recorded and documented in Excel. Furthermore, the time rabbits spent with feeding in the course of the day were analysed using 24 h infrared video recording with video camera above the flat decks.

Chemical Analyses

After 4 weeks, rabbits were slaughtered in the morning and the following parameters were determined: stomach weight and pH value of the stomach chyme were measured two times at the cardia area, fundus area and pylorus area. Dry matter (DM) of stomach and caecal chyme was measured with conventional methods.

Particle sizes of the stomach and caecum chyme and faeces were measured by wet sieve analysis with the following mesh widths: 1, 0.5 and 0.2 mm as well as filtering the finest particles with glass filter paper (middle particle hold property = 0.6 µm). Sieve fractions were transferred onto paper filters and dried for 4 h with 105 °C – cooled in desiccator and reweighed for calculation of the percentage of every fraction.

Statistical Analysis
Data were calculated in Excel and converted in SPSS 20.0. Test of normal distribution was done and T-test was executed to determine significant differences.

RESULTS AND DISCUSSION

In the course of the day, rabbits fed chopped hay spent more time (6.76 hours per day) with feed intake than those fed with pelleted feedstuff (2.44 hours per day) or grinded alfalfa (3.51 hours per day). Also the feed intake time for 0.1 g of feedstuff – measured in the special observation box – was up to 5 times faster for pellets (5.1 sec) compared to alfalfa hay (26.8 sec.). This may be the reason for the more frequent use of the gnawing stick by rabbits fed with pelleted feedstuff. The use of the gnawing stick in groups fed with pelleted alfalfa was significantly more intensive (57.7% abrasion) than in rabbits fed with grinded alfalfa (31.7%) or hay chopped (21.9%) (Table 2).

Table 2: Results of the feed intake time (h/24h), feed uptake time in sec. per 0.1 g and the wear and tear of the gnawing stick (n, mean, SEM and P values).

	Chopped (A)			Pelleted (B)			Grinded (C)			Significances
	n	mean	SEM	n	mean	SEM	n	mean	SEM	(t-Test)
seconds needed for uptake 0.1 g	6	26.8	4.50	6	5.1	0.44	6	26.8	8.42	A to B P = 0.005 A to C = n.s. B to C P = 0.049
feed intake time in 24 h (in hours)	4	6.8	0.11	4	2.4	0.22	4	3.5	0.36	A to B and C P ≤ 0.001 B to C P = 0,01
abrasion of the gnawing stick (%)	3	21.9		3	57.7		3	31.7		not tested because of the low n

Because of some water and feedstuff losses in every group the consumption could not be measured. Also the pH values in cardia area of the stomach varied because of the different presence of soft faeces, so the measured pH values of fundus and pylorus area were analysed only. Rabbits fed with meal showed ($P<0.001$) lower pH values in both areas of stomach chyme than those fed with chopped hay or pellets. The highest ($P<0.05$) pH values in fundus and pylorus area were measured in stomach of rabbits fed with pelleted alfalfa (Table 3). Also rabbits fed the pelleted alfalfa showed the heaviest stomach weight (272 g) compared to the other groups. The dry matter content in stomach chyme was similar among treatment. Rabbits fed with chopped alfalfa hay showed a significantly ($P<0.01$) lower dry matter content (13.9%) in caecal chyme than those fed with grinded (17.5%) or pelleted alfalfa (20.0%).

The results of the wet sieve analysis showed nearly identical percentages in all sieve fractions of stomach chyme from rabbits fed with pellets or meal. The results of particle size in stomach chyme from rabbits fed with hay chopped were different in all fractions excluded the finest. In caecal chyme no differences concerning the largest and finest particle size between rabbits of the three feedstuff variants were found. This effect can be explained by digestion physiology. Only the smaller particle sizes flow back into the caecum. Hence, in rabbits fed with hay the highest percentage of big particles were excreted through the colon. This process may explain the higher dry matter content in caecal chyme in rabbits fed with pellets or meal. The high percentage of finest particles flowed completely into the caecum which increased the dry matter content.

Table 3: Results of weighing, pH value, DM and particle size measurement (n, mean, SEM and P values).

		Weight	pH value		DM		Particle size stomach				Particle size caecum			
		Sto-mach	Fundus area	Pylorus area	Stomach	Caecum	<0.2	<0.5 - >0.2	<1.0 - >0.5	>1.0	<0.2	<0.5 - >0.2	<1.0 - >0.5	>1.0
		(g)			(%)			(%)				(%)		
Hay chopped A	n	16	16	16	8	8			24				24	
	mean	232	1.29	1.21[a]	15.8	13.9	6.91	5.25	7.66	80.19	29.22	4.89	6.15	59.73
	SEM	15.4	0.07	0.05	0.8	0.5	0.85	0.98	2.06	1.92	6.86	1.51	0.96	5.23
Pellets B	mean	272	1.49	1.42[b]	16.9	20.0	7.45	14.73	21.14	56.67	20.33	14.91	10.50	54.26
	SEM	6.9	0.12	0.09	0.5	1.6	1.32	3.36	3.65	1.88	3.62	1.82	1.44	4.86
Meal C	mean	208	0.84	0.95[c]	15.9	17.5	8.51	11.48	25.67	54.34	14.89	11.89	17.75	55.46
	SEM	13.0	0.05	0.03	0.9	0.9	2.44	2.22	6.53	4.99	2.00	3.15	2.24	4.13
P-Value (T-test)		B to A & C P<0.05	C to A & B P<0.001	A & B to C P<0.001	n.s.	A to B & C P<0.02	n.s.	A to B & C P<0.05	A to B & C P<0.05	A to B & C P<0.002	n.s.	A to B & C P<0.05	A to B & C P<0.05	n.s.

CONCLUSIONS

A clear effect of the feed structure on feeding behaviour and some digestive physiology parameters was shown. Fine fractions of feedstuff pressed in pellets gave rabbits the possibility of a very fast feed intake. So, feeding pelleted feedstuff results in shorter feed intake duration in the course of the day which in turn may have stimulated the more intensive use of the gnawing stick. Feeding with pellets having a high level of fine particles resulted in a higher caecal dry matter content.

REFERENCES

Dinges J., Lang C., Hoy St. 2011. Feed intake behaviour of growing rabbits fed with three different feedstuffs. *In Proc. 17th international Symposium on housing and diseases of rabbits, furproviding animals and pet, 2011 May, Celle, Germany, 239 – 250*

García J., Carabano R., Perez-Alba L., de Blas, C. 2000. Effect of fiber source on cecal fermentation and nitrogen recycled through cecotrophy in rabbits. *J.Anim.Sci:78, 638-646*

Gidenne T. 1992. Effect of fibre level, particle size and adaptation period on digestibility and rate of passage as measured at the ileum and in the faeces in the adult rabbit. *Br. J. Nutr., 67: 133-146*

Gidenne T. 1993. Measurement of the rate of passage in restrictedfed rabbits: effect of dietary cell wall level on the transit of fibre particles of different sizes. *Anim. Feed Sci. Technol. 42: 151-163*

Greißl S., Lang C., Hoy St. 2011. Consumption rate in growing rabbits fed with different feedstuffs. *In Proc. 17th international Symposium on housing and diseases of rabbits, furproviding animals and pet, 2011 May, Celle, Germany, 259-268*

Lang C., Hinchliffe D., Weirich C., Hoy St. 2011a. Effect of three different feedstuffs on parameters of digestion in growing rabbits. *In Proc. 17th international Symposium on housing and diseases of rabbits, furproviding animals and pet, 2011 May, Celle, Germany, 160-168*

Lang C., Weirich C., Hoy St. 2011b. Frequency of Occupation with Different Objects by growing Rabbits under Various Conditions. *J. Agric. Sci. Techn. A, 833 – 841*

Lang C., Hinchliffe D., Brendle J., Weirich C., Hoy St. 2016. Effect of differently structured and processed feedstuffs on diverse parameters of ethology and digestibility of growing rabbits and their influence on morphological structures in small intestine, *Berl Münch Tierärzt Wochens, 129, 153 - 159*

Lebas F. 2000. Granulométrie des aliments composés et fonctionnement digestif du lapin. *INRA Prod. Anim., 13:109-116*

Prebble J. L., Langford F. M., Shaw D. J., Meredith A. L. 2015. The effect of four different feeding regimes on rabbit behaviour. *Appl. Anim. Behav. Sci. 169, 86 – 92*

Wolf P., Zumbrock B., Kamphues J. 2010. Untersuchungen zu möglichen Einflüssen der Rasse auf die relative Größe des magen-Darm-Traktes sowie die Zussammensetzung des Chymus bei Kaninchen, *Züchtungskunde 82, 165 - 175*

Wolf P., Zumbrock B., Kamphues J. 2007. Untersuchungen zur Zusammensetzung der Caecotrophe bei verschiedenen Kaninchenrassen in Abhängigkeit von der Fütterung. *In Proc. 15th international Symposium on housing and diseases of rabbits, furproviding animals and pet, 2007 May, Celle, Germany, 145 – 15*

==========