Effect of dietary supplementation of fresh red chicory (*Chicorium intybus foliosum*) on gastro-intestinal tract and caecal fermentation of rabbit before weaning

Cardinali R., Dal Bosco A., Castellini C.

Dipartimento di Biologia Applicata, Università di Perugia, Italy

Corresponding Author: Raffaella Cardinali, Dipartimento di Biologia Applicata. Università di Perugia. Borgo XX Giugno 74, 61121 Perugia (PG), Italy - Tel. +39 075 5857116 - Fax: +39 075 5857122 - Email: rcardinali@inwind.it

ABSTRACT: The aim of the study was to evaluate the effect of the administration of red fresh chicory (*Chicorium intybus foliosum*) to young pups before the weaning. Immediately after kindling 16 New Zealand White (NZW) multiparous rabbit does were homogenised for litter size (n=8) and at 16 days, when the nest was opened, they were divided in two groups: control group, in which young rabbits fed control diet; chicory group, in which young rabbits were fed control diet and fresh chicory, separately. The chicory leaves were roughly cut and administrated on the top of the nest from 16 days of lactation until weaning (30 day), when 10 young rabbits/group were weighted and killed by cervical dislocation. The dietary administration of red fresh chicory to young rabbits before weaning increased the *caecum* weight ($P<0.05$) for a high water (94 %) of leaves and improved biochemical traits of *caecum* content: the increased VFA ($P<0.05$) content indicated a higher fermentation of gut microflora. In conclusion these results can imply that red chicory could be considered an additive rather than a feed.

Key words: Fresh red chicory, Gastro-intestinal tract, Caecal fermentation.

INTRODUCTION – There is some evidence in the literature indicating a beneficial effect of inulin-type fructans in rabbit nutrition (Volek *et al.*, 2007). In the rabbit, the fermentation pattern of the large bowels (caecum and colon) seems to be a predominant factor in the maintenance of the health conditions. Some studies have reported that dietary supplementation of fructan-type oligosaccharides (FOS) may produce beneficial changes to the metabolism of the gastrointestinal tract, by modifying the hepatic lipid metabolism (Delzenne *et al.*, 2002). The young rabbits start to take in small amounts of solid feed at 16-18 days of age (Szendrõ *et al.*, 2000) and at weaning age (28 days) the feed intake is low because the milk production of the doe is still relevant. In order to modulate caecal fermentation, some Authors used various FOS, which are not digested in the upper intestine and remain available for the fermentation by the caecal flora (Fishbein *et al.*, 1988). However around weaning, the kits need lower protein and starch and more digestible and/or indigestible fibre content in the diet in order to maintain a good intestinal health (Gidenne and Garcia, 2006). The chicory leaves are the most concentrated sources of FOS and inulin and thus, the purpose of the present study was to evaluate the effect of their administration on young rabbits before weaning.

MATERIALS AND METHODS – The trial was carried out at the experimental farm of the Department of Applied Biology of the University of Perugia. Immediately after

kindling, 16 New Zealand White (NZW) multiparous rabbit does were homogenised for litter size (n=8) and were divided into two groups:

- Control group: fed a standard diet;
- Chicory group: in which young rabbits were fed control diet and fresh chicory leaves.

Controlled lactation was performed until 15 days; the nest box was opened for half an hour starting from 8:00 a.m. From 16 to 30 days, the nest box remained closed in the afternoon, to avoid ingestion of chicory by the does and the solid feed by the young rabbits; chicory was weighted and administrated to litter *ad libitum*. Fresh red chicory leaves were roughly cut and administrated in the top of the nest starting from 16 days of lactation until weaning (30 days). Almost all the chicory furnished was ingested by pups and the scanty quantity remained in the nest floor was daily weighted. The composition of feed was: crude protein 18.7%, crude fibre 14.7%, fat 4.8% and digestible energy 10.9 MJ/kg (Maertens *et al.*, 1988). The water were provided *ad libitum.* Litters were weighted at 16 days and at weaning, when 10 young rabbits/group were randomly selected, weighted and killed by cervical dislocation. The liver, gastro-intestinal tract and *caecum* were removed and weighted. The net body weight was also calculated. On the caecal content pH, dry matter, ammonia (Verdouw et al., 1977) and volatile fatty acid (VFA) were evaluated. For VFA determination Mega 2 Carlo Erba Gas Chromatograph (model HRGC - Milano, Italy), with a Mega capillary column (0.32 mm ∅, 0.25 m long) was used. Statistical analysis was carried out using a linear model (StataCorp, 2005) with the fixed effect of dietary treatment.

RISULTS AND CONCLUSION – The lower feed intake during pre-weaning period in the red chicory group was probably due to a lower ingestion of solid feed, limited to only morning, substituted by red chicory which, in turn, had a very high water (94 %) and low levels of protein (1.4 %) and lipid (0.1 %) (Table 1); these data also explain the higher *caecum* weight ($P<0.05$) and the lower dry matter (-0.9%; $P<0.05$) of caecal content in red chicory group, according to Juśkiewicz *et al*. (2007). The body weight at 16 days of age was similar in the two groups, but at the end of experimental period the control group showed the higher body weight (+55g; $P<0.05$) and net body weight (+28.2g; $P<0.05$). Any mortality case was recorded.

Regarding the influence of red chicory ingestion on the caecal fermentation, the major final metabolites of FOS could have contribute to increase VFA production and to reduce pH level. The VFA profile increases regularly as the microbial developed (Combes *et al*., 2011) and it has been shown to be related to the microbiota characteristics rather than to the quality of the nutrients entering the *caecum*. The high VFA value in red chicory group could be the result of the lower protein content of leaves. Volek and Marounek (2010) analyzing the effect of dried chicory root integration on rabbit from 31 to 73 days of age, recorded only a tendency for a VFA increase, even if not statistical significance. These results can imply that red chicory could be considered an additive rather than a feed. Further analyses are needed to have a complete view also considering the possibility to apply this strategy to fattening period.

Table 1 – Effect of chicory on litter performance and gastro-intestinal tract and on main parameters of caecal content

		Control	**Chicory group**	**SED**
Feed intake (16-30d)	g/d/rabbit	28	26	4
Chicory intake (16-30d)	"	-	16	-
Weight at 16 d	g	255.4	268.5	15.6
Weight at 30 d	"	543.3b	488.3a	41.5
Net body weight	"	279.5b	251.3a	18.5
Caecum weight	% l.w.	3.5a	4.0b	0.3
Gastro-intestinal weight	"	21.2	20.9	0.9
Liver weight	"	3.4	3.5	0.2
Caecal content				
Dry matter	%	23.8b	22.9a	0.3
pH		6.1	5.9	0.4
NH_3	µmmol/L	0.7	0.5	0.3
VFA	mmol/Kg	56.6b	64.3a	8.5.

N=20; P<0,05: a,b.

REFERENCES – **Combes**, S., Michelland, R.J., Monteils, V., Cauquil, L., Souliè, V., Tra, N.U., Gidenne, T., Fortun-Lamothe, L., 2011. Postnatal development of the rabbit caecal microbiota composition and activity. FEMS Microbiol. Ecol. 77:680-689. **Delzenne**, N.M., Daubioul, C., Neyrinck, A., Lasa, M., Taper, H.S., 2002. Inulin and oligofructose modulate lipid metabolism in animals: reviews of biochemical events and future prospects. Br. J.Nutr. 87: 255-259. **Fishbein**, L., Kaplan, M., Gough, M., 1988. Fructo-oligosaccharides:a review. Vet. Hum. Toxicol. 30: 19-60. **Gidenne**, T., Garcia, J., 2006. Nutritional and feeding strategies improving the digestive health of the young rabbit. In: Maertens, L., Coudert, P. (Eds). Recent advances in rabbit sciences. ILVO. Merelveke, Belgium. pp. 229-238. **Juśkiewicz**, J., Ašmanskite, L., Zduńczyk, Z., Matusevičius, P., Wròblewska, M., Žilinskiene, A., 2007. Metabolic response of the gastrointestinal tract and serum parameters of rabbits to diets containing chicory flour rich in inulin. J. Anim. Physiol. Anim. Nutr. 92:113-120. **Maertens**, L., Moermans, R., De Groote, G., 1988. Prediction of the apparent digestible energy content of commercial pelleted feeds for rabbits. J. Appl. Rabbit Res. 11:60-67. **StataCorp,** 2005. Stata Statistical Software: Release 9.0 College Station, TX: StataCorp. **Szendrõ**, Z., 2000. The nutritional status of foetus and suckling rabbits and its effects on their subsequent productivity. In Proc. 7th World Rabbit Congress, Valencia, Spain, pp 375-393. **Verdouw**, H., Echteld, C.J.A., Dekkers, E.M.J., 1977. Ammonia determination based on indophenol formation with sodium salicylate. Water Res. 12:399-402. **Volek**, Z., Marounek, M., Skřivanovà, V., 2007. Effect of a starter diet supplementation with mannan-oligosaccharides or inulin on health status, caecal metabolism, digestibility of nutrients and growth of early weaned rabbits. Animal 1:523-530. **Volek**, Z., Marounek, M., 2010. Dried chicory roots (*Chicorium Intybus L*) as a prospective ingredient for the rabbit diet. In. Proc. 4thCongreso de Cunicoltura de las Amèricas.