# DIETARY FIBRE AND CHRONIC DISEASE IN THE DOG : FROM THEORY TO PRACTICE

Marianne Diez[1] and Louis Istasse[2]
DVM, D.Sc.Vét[1], DVM, PhD[2]- Animal Nutrition Unit, Faculty of Veterinary Medicine, B43,
University of Liège, B 4000- Liège, Belgium

## INTRODUCTION

Although dietary fibres (DF) are not essential nutrients, they are natural components of wild canidaes's regimens. The wild canidaes can eat directly vegetables as fruits or berries (Alderton, 1994) or herbivorous preys containing DF in their digestive tract.

For some decades, the sector of pet food has grown and put on the market complete and balanced products to meet the requirements of all life stages (growth, maintenance, reproduction and ageing). Otherwise, the sedentary lifestyle of dogs -which is related to a close contact with man- favoured the outbreak or the increase of frequency of metabolic diseases such as obesity, diabetes mellitus and secondary hyperlipidaemia. Therefore specific-purpose diets help to prevent or treat more than 20 different diseases.

In human nutrition, the new concept of "functional food" appealed to many consumers concerned with their health. The words "nutraceuticals or functional foods" refer to number of foods such as milk-based products containing pre- or pro- biotics (oligosaccharides, inulin, ...). The same consumers are also concerned with the health of their pets and are also interested by functional foods specially formulated for dogs and cats.

Seven trials were conducted to study the effects of adding DF in dog's diet. Various DF sources - cellulose, beet pulp, beet fibre, chicory pulp, inulin, fructooligosaccharides and guar gum- were studied by our team in healthy (6 studies) and in obese ( 1 study) dogs to assess their effects and develop their use in the treatment of chronic diseases (Table I).

**Table 1.**— Sources and incorporation rates of DF used in the 7 trials

| | Number of studies[1] | Concentration % DM[2] | TDF[3] % DM |
|---|---|---|---|
| Cellulose (Cel) | 3 | 3.4/7.1 | 3.1/6.3 |
| Guar Gum (GG) | 5 | 3.4/4.3/6.5 | 3.3/4.2/6.3 |
| Pectins (Pec) | 1 | 3.4 | 2.7 |
| Inulin (In) | 1 | 6.5 | 1.8 |
| Fructooligosaccharides/ Beet fibre (FOS) | 1 | 5.0/10.2 | 4.8/9.7 |
| Beet pulp (BP) | 1 | 18.6 | 14.2 |
| Beet fibre (BF) | 1 | 6.5/9.4 | 4.7/6.8 |
| Chicory pulp (CP) | 3 | 14.6 | 11.1 |
| Guar Gum/ cellulose (GG /Cel) | 2 | 7.4 | 6.8 |

*1 Number of studies in which DF were tested*
*2 DM, dry matter*
*3 TDF, total dietary fibre*

After incorporation of different rates of purified DF in home-made diets, faeces characteristics, drinking water consumption and nutrient digestibility were recorded. Plasma metabolites (glucose, insulin, α-amino-nitrogen, urea, cholesterol and triglycerides) were measured in fasted dogs and then serially during 6 hours after the meal (Diez, 1998).

**RESULTS**

Apparent digestibility coefficients of TDF (total DF) and IDF (insoluble DF) varied to a large extent: from 27 to 78 % for TDF and from 6 to 41 % for IDF (Figure 1).

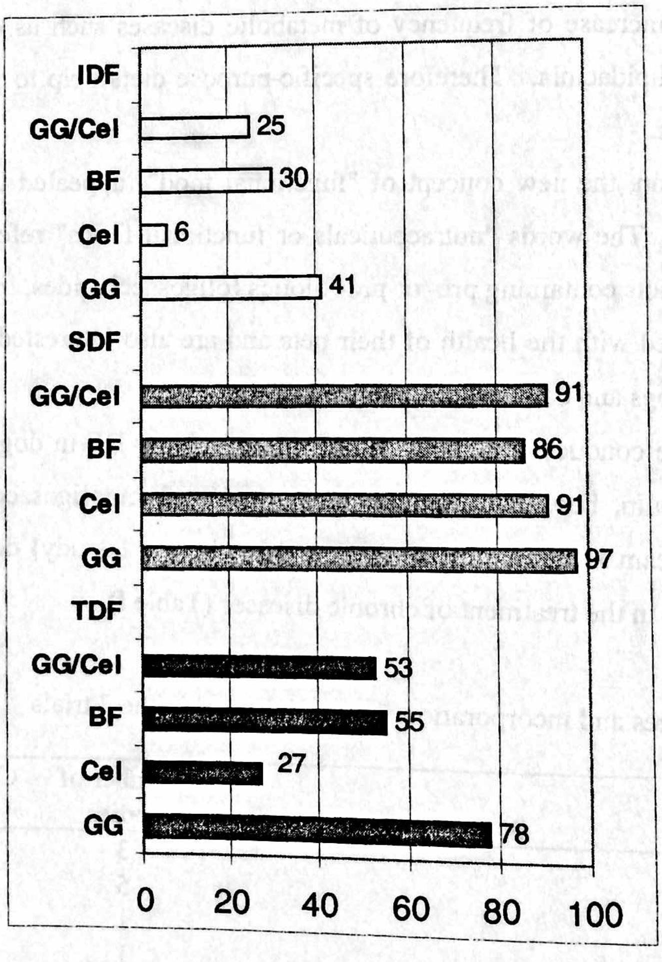


**Figure 1-** Digestibility coefficients of SDF, IDF and TDF in 4 diets containing 9.1-11.4 %TDF in dry matter

By contrast, digestibility of SDF (soluble DF) was always over 85 %. The results suggest that guar gum is completely fermented in the large bowel. The largest decreases of TDF digestibility were induced by diets containing cellulose -used alone or mixed with GG- and with beet fibre, rich in insoluble fibre.

Beet fibre and beet pulp were characterised by a high water-binding capacity. They improved the structure of faeces but increased dramatically the weight of fresh faeces and the dry matter excretion and decreased the dry matter concentration (Figures 2, 3, 4).

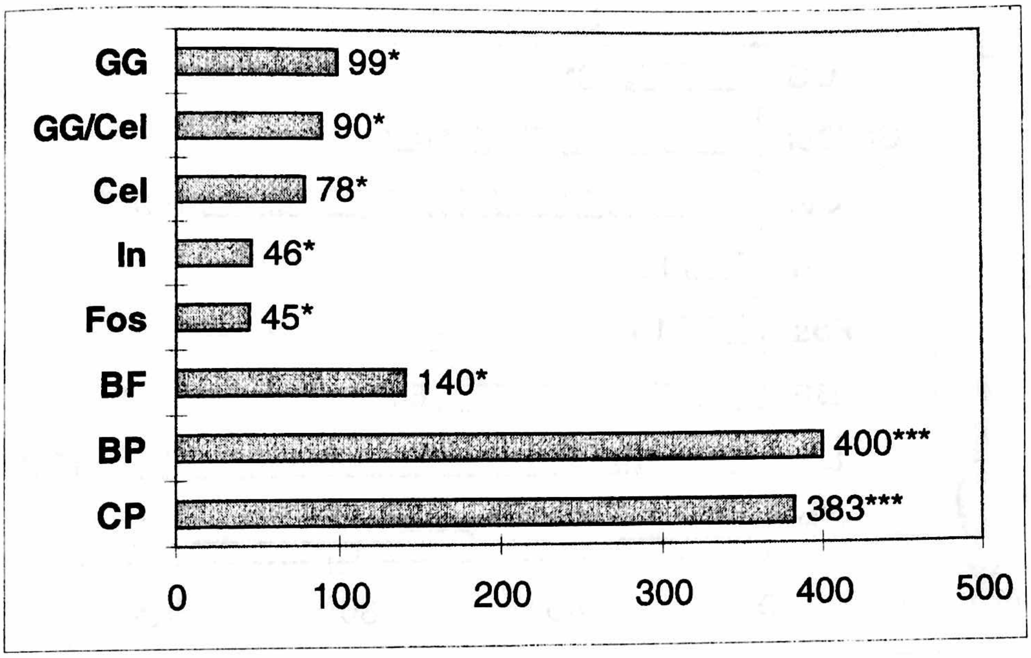


**Figure 2-** Effects of DF on faeces characteristics : daily wet weight excretion (%, compared with control) ( for this figure and the following : * P< 0.05; ** P< 0.01; *** P< 0.001)

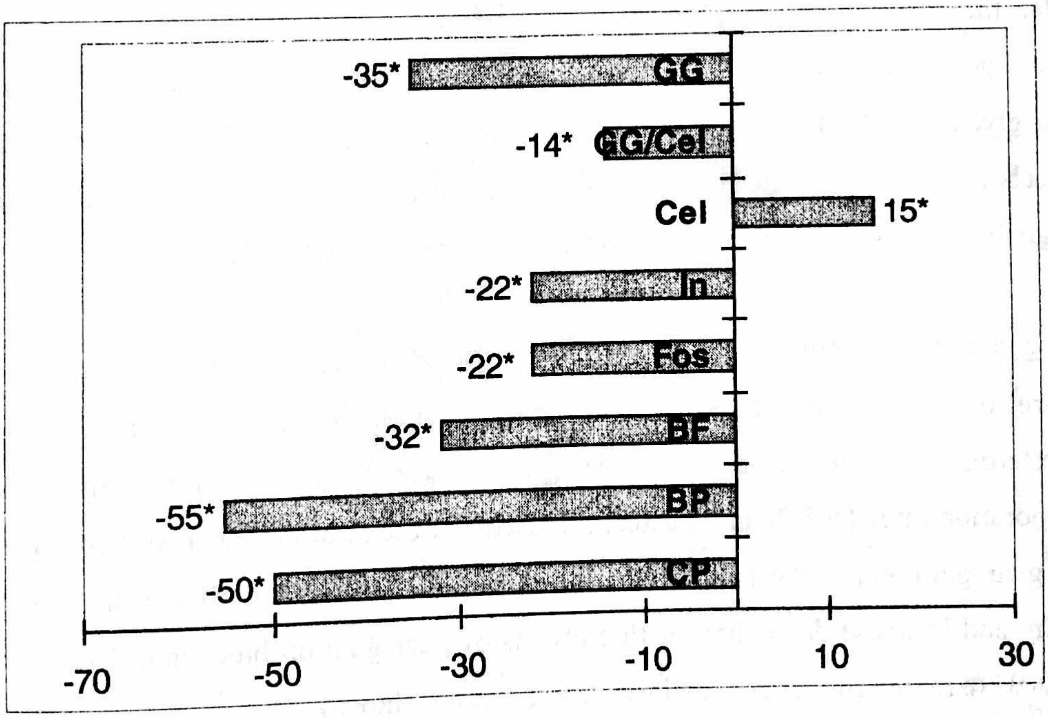


**Figure 3-** Effects of DF on faeces characteristics : dry matter concentration (%, compared with control)

They also increased drinking water consumption. Voluntary drinking water consumption was 7 ml/kg BW/day in control dogs and it increased up to 10.5 ml ($P<0.01$) with beet fibre. When used at an incorporation rate < 9 % dry matter, beet by-products had no effect on plasma metabolites. Incorporation of high rates (15 % total DF) of beet pulp or <u>chicory pulp</u> decreased plasma glucose concentration in fasted dogs and plasma insulin, triglycerides, urea and cholesterol concentrations, both in fasted animals and after the meal (Diez et al., 1997b).

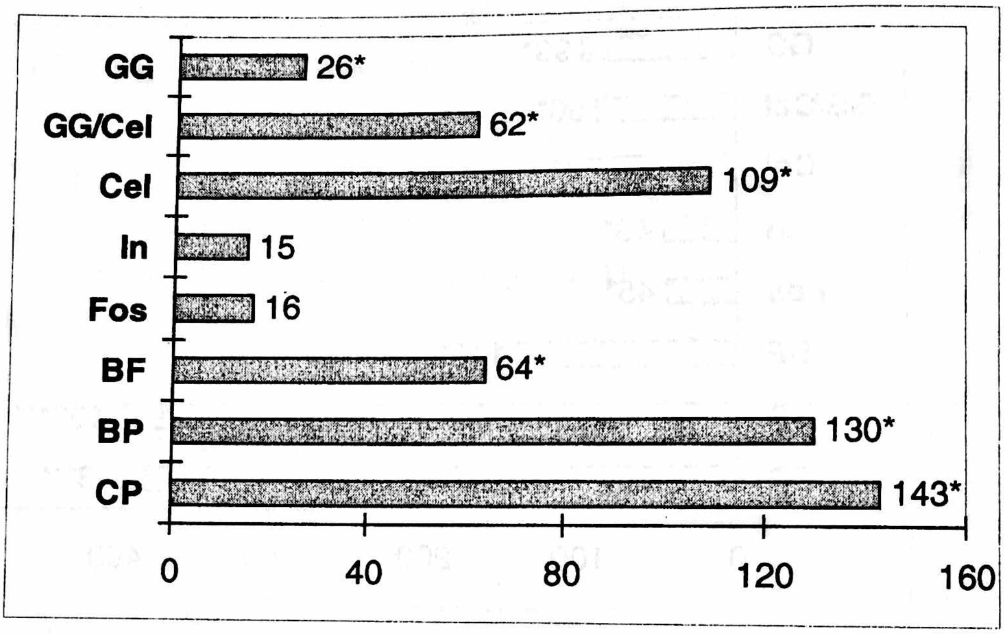


**Figure 4-** Effects of DF on faeces characteristics : dry matter excretion (%, compared with control)

<u>Fructooligosaccharides</u> were associated with beet fibre in a ratio 4-to-1 in order to prevent liquid stools; the blend was tested at two incorporation rates of 5 and 10 % dry matter. Using fructooligosaccharides at the high rate decreased postprandial plasma concentrations of glucose, urea and triglycerides ($P<0.01$). A 6-week trial with fructooligosaccharides revealed decreases of plasma urea, cholesterol and triglycerides concentrations in fasted dogs. The decrease of plasma cholesterol was gradual and became obvious two weeks after starting the trial (Figure 5).

<u>Guar gum</u> induced many metabolic effects : decreased plasma cholesterol concentration in fasted dogs (Figure 6) and decreased postprandial concentrations of insulin, α-amino-nitrogen, urea and cholesterol. Guar gum must be associated with insoluble fibre to prevent runny faeces when high incorporation rates (> 5 % dry matter) are used. A blend of cellulose and guar gum was compared with guar gum alone; the results on plasma metabolites were similar. Comparison of DF both in healthy and in obese dogs showed that effects of guar gum on biochemical parameters -insulin and lipids- were more pronounced in obese dogs (data not shown).

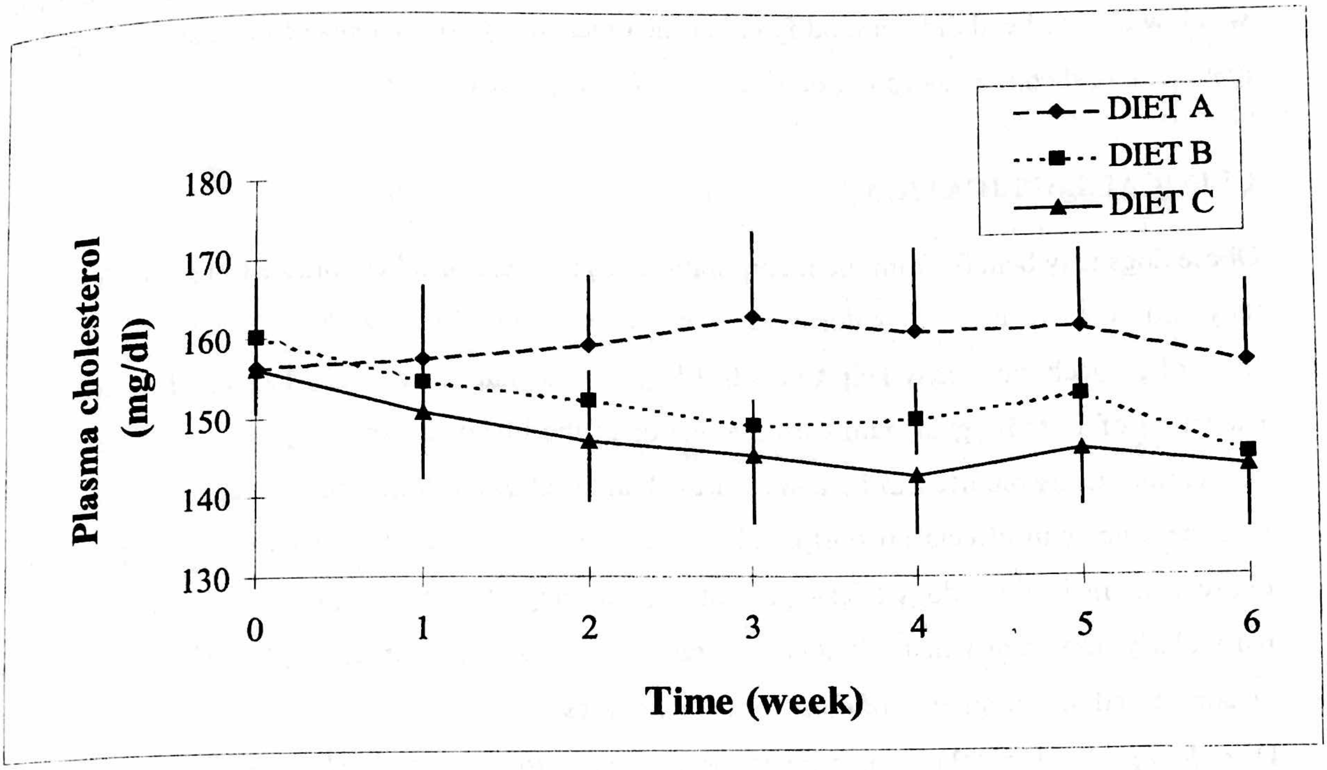


**Figure 5** - Evolution in plasma cholesterol concentration (mean ± SEM) in 8 healthy Beagle dogs fed diets containing different incorporation rates of a blend of fructooligosaccharides and beet fibre (Diet A, control ; Diet B, 5.0 % ; Diet C, 10.2 %)

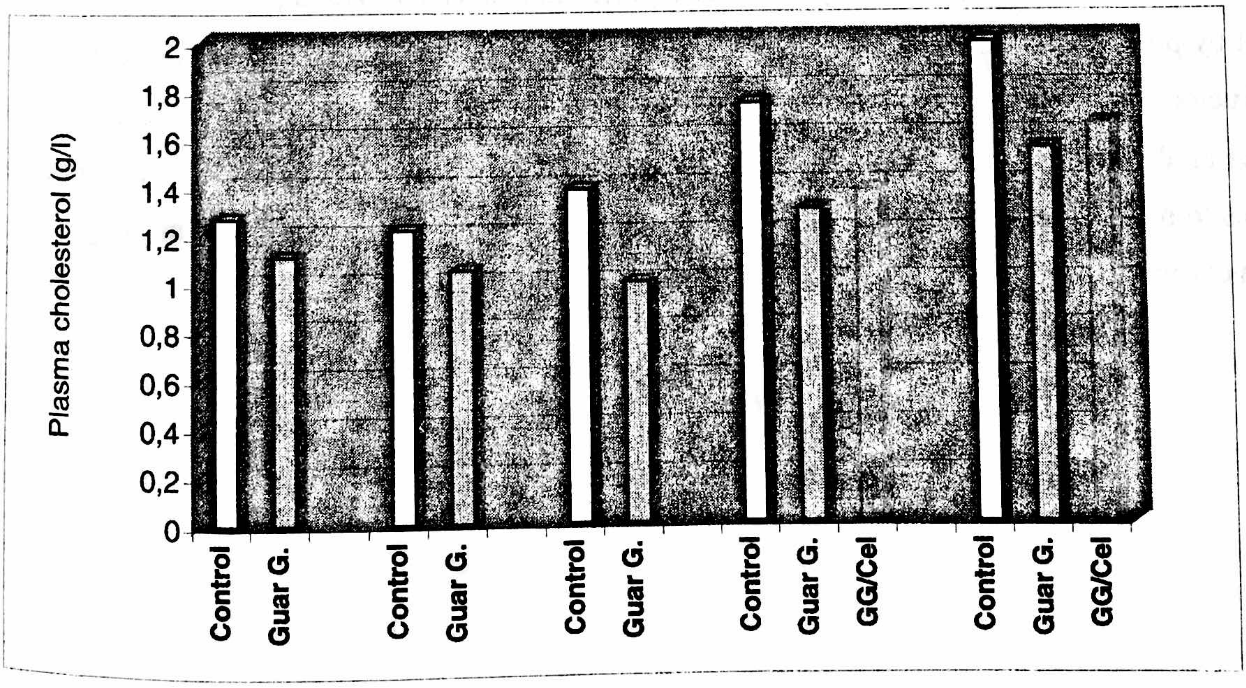


**Figure 6** - Influence of guar gum (3.3-6.3 % TDF in DM) and of a blend of guar gum and cellulose (6.8 % TDF in DM) on plasma cholesterol concentration in non-fed dogs in 5 experimental trials

Unlike other DF, cellulose did not decrease dry matter concentration of faeces (Figure 3). Cellulose was low digested and did not modify either the digestibility coefficients of main nutrients, nor plasma metabolites when the incorporation rate was < 7 % dry matter.

## CLINICAL IMPLICATIONS

Obese dogs may benefit from the incorporation of guar gum or other soluble fibre in their diet even if they do not receive a calorie-restricted diet. In dogs with diabetes mellitus, adding fructooligosaccharides may help to control hyperglycaemia (Diez et al., 1997a). However, with the exception of 1 study, guar gum - used alone or in the blend- decreased postprandial insulin plasma concentrations as reported in human studies (Landin et *al.*, 1992). Moreover, it should be noticed that the guar gum effects on postprandial plasma insulin concentrations were more pronounced in obese than in healthy dogs. The present results suggest that the guar gum lowering effects are particularly important when initial concentrations of plasma insulin are high. This last point should be considered in formulation of diets for diabetic dogs.

Disorders of lipid metabolism, primary or secondary to other clinical disorders (diabetes mellitus, chronic renal disease, chronic pancreatitis) are not rare in dogs : an incidence of 14.3 % was reported (Barrie et al., 1993). Hyperlipidaemia are one of the main indications to use DF. Adding a single daily supplement of short-chain fructooligosaccharides is useful to diminish high plasma concentrations of triglycerides or total cholesterol (Diez et al., 1997a), as reported in rats (Fiordaliso et al., 1995). Guar gum lowered cholesterol plasma concentrations both in fasted dogs and after the meal (Diez et al., 1997c , 1998) as previously reported in man (Landin et al., 1992)

Beet by-products can prevent constipation in the dog. Despite a chemical composition similar to that of fructooligosaccharides, inulin induced no interesting effects for dietary therapy of chronic diseases (Diez et al., 1998). From the present experiments in healthy dogs, the use of DF to control uraemia seems to be interesting but remains to be confirmed by controlled studies in azotaemic dogs suffering from chronic renal disease.

## REFERENCES

ALDERTON D. Foxes, wolves and wild dogs of the world. 1994, Ed. Blandford, London, pp 192.

BARRIE J., WATSON T.G.D., STEAR M.J., NASH A.S. Plasma cholesterol and lipoprotein concentrations in the dog : the effects of age, breed, gender and endocrine disease. *J. Small Anim. Pract.*, 1993, **34,** 507-512.

DIEZ M., J.L. HORNICK, P. BALDWIN, L. ISTASSE. Influence of a blend of fructo-oligosaccharides and sugar beet fiber on nutrient digestibility and plasma metabolites concentrations in healthy Beagles, *Am. J. Vet. Res.* 1997a, **58** : 1238-1242.

DIEZ M, J.L. HORNICK, C. VAN EENAEME, P. BALDWIN, L. ISTASSE. Fibres alimentaires chez le chien : influence de l'incorporation de pulpes de betterave ou de chicorée sur la digestibilité des nutriments et les concentrations plasmatiques de plusieurs métabolites. *Rev. Méd. Vét.* 1997b, **148** : 991-998.

DIEZ M., C. VAN EENAEME, J.L. HORNICK, P. BALDWIN, L. ISTASSE. Dietary fibre in dogs diet : comparisons between cellulose, pectin, guar gum, and between two incorporation rates of guar gum. *J. Anim. Physiol. a. Anim. Nutr.* 1997c, **78** : 220-229.

DIEZ M. Contribution à l'étude des fibres alimentaires chez le chien : effets sur les paramètres fécaux, la digestibilité des nutriments et les métabolites sanguins. Thèse de doctorat. Presses de la faculté de Médecine Vétérinaire de l'Université de Liège, Belgique, 1998, pp 321.

DIEZ M., J.L. HORNICK, P. BALDWIN and L. ISTASSE. The influence of sugar beet fibre, guar gum and inulin on nutrients digestibility, water consumption and plasma metabolites in healthy Beagle dogs. *Res. Vet. Sci.* 1998, **64** : 91-96.

FIORDALISO M., KOK N., DESAGER J., GOETHALS F., DEBOYSER D., ROBERFROID M., DELZENNE N. Dietary oligofructose lowers triglycerides, phospholipids and cholesterol in serum and very low density lipoproteins of rats. *Lipids*, 1995, **30**, 163-167.

LANDIN K., HOLM G., TENGBORN L., SMITH U. Guar gum improves insulin sensibility, blood lipids, blood pressure and fibrinolysis in healthy men. *Am. J. Clin. Nutr.*, 1992, **56**, 1061-1065.