Fibra d'Acacia

Fibra d'Acacia - 170 gr

gomma arabica

è una ***Fibra solubile non gelificante***, estratta per purificazione dalla gomma "arabica" della Acacia Senegal. E' insapore e a temperatura ambiente è facilmente solubile, ideale sia per aumentare la flora batterica nelle disibiosi, che per fare un "aumento di massa" nelle rieducazioni intestinali.

fibra d'Acacia

- **Attività**:
  - **F**lora batterica (bifidogenica),
  - **A**ssorbimento nutrienti idrofili e lipofili (emulsionante, produzione di ac. butirrico da fermentazione)
  - **A**mmoniemia e uricemia
  - **A**ntiossidante (ramnosio e ac. glucuronico)
  - **P**rotezione intestinale ed epato-renale
  - **T**ransito: regolarizza l'alvo (riduce la diarrea e, a dosi elevate, aumenta il transito: (NO scavenger e inibitore nel piccolo intestino della NO sintetasi (NOS)).
- **Impieghi**: disibiosi, candidosi, diverticolosi, malassorbimenti, rettocolite, rieducazione del colon irritabile, stipsi leggera, diminuita funzionalità renale ed epatica. In cucina trova uso come addensante.
- **Posologia**:
  - Per l'"**aumento della massa**" assumere al pasto, aumentando progressivamente da 1 a 4 o più cucchiaini al giorno in acqua o altra bevanda a **temperatura ambiente**. *(Se aggiunta ad una bevanda calda tende ad addensare, fino alla formazione ad alte concentrazioni di una gomma).*
  - Per avere l'**Effetto "fermentatore"**, cioè nutrire al meglio la **flora batterica** che si replicherà rapidamente *(circa 1 volta all'ora), (il che porta ad aumentare l'assorbimento di acqua, sali e microelementi, le vitamine B, migliora il nutrimento degli endociti e riduce l'ammoniaca)* : sciogliere dai 6 a 10 gr (3-4 cucchiaini da caffè) in un litro d'acqua o di tisana *(solitamente con camomilla e/o melissa)*, ed assumerla lentamente nella giornata. In caso di **diarrea** si faranno assumere per un breve periodo anche dei buoni fermenti *(es VSL3 sigma-tau)*, che pertanto ripopoleranno subito l'intestino, in tal caso è consigliabile abbinare il Paxacol *(2-3 cucchiaini da the fuori dai pasti).-*
  - **IMPORTANTE**: per ridurre le fermentazioni indesiderate nella tisana *(visto che non si opera in condizioni di sterilità)*, particolarmente in estate; si suggerisce di dividere il litro di tisana in due bottiglie di cui una da tenere in frigo ed assumerla nel pomeriggio.

Livi

Chemical Structure
The gums from Acacia senegal and Acacia seyal are complex polysaccharides and both contain a small amount of nitrogenous material that cannot be removed by purification. Their chemical compositions vary slightly with source, climate, season, age of the tree etc. but typical analytical data for each are given in Table 3.2. The gums consist of the same sugar residues but Acacia seyal gum has lower rhamnose and glucuronic acid contents and higher arabinose and 4-O-methyl glucuronic acid contents than gum from Acacia senegal. Acacia seyal gum contains a lower proportion of nitrogen and the specific rotations are also very different. Determination of these latter parameters can provide a rapid means of differentiating between the two species. The amino acid compositions are similar (Table 3.3), with hydroxyproline and serine the major constituents.

Table 3.2: Characteristics of gum from *Acacia senegal* and *Acacia seyal*

	Acacia senegal	Acacia seyal
Specific rotation/ degrees	-30	+51
Average molecular mass (Mw)	380,000	850,000
4-O-methyl glucuronic acid	1.5	5.5
% rhamnose	13	4
% nitrogen	0.36	0.15
% glucuronic acid	14.5	6.5
% galactose	44	38
% arabinose	27	46

Both gums have complex molecular mass distributions that display similar features but the average molecular mass of gum from Acacia seyal is higher than that of Acacia senegal (Table 3.2). Typical molecular mass profiles of the two gums obtained by gel permeation chromatography using refractive index coupled with light scattering detection and UV absorbance (206nm) detection are presented in Figures 3.1a and 3.1b respectively. Refractive index is a sensitive measure of gum concentration and the profiles indicate that the gums consist of two components, the main one (peak 1) representing ~90% of the total with a molecular mass of a few hundred thousand and the other (peak 2) which represents about 10% of the total with a molecular mass of several million

Table 3.3: Amino acid composition of *Acacia senegal* and *Acacia seyal* gums (residues/1000 residues)

	Acacia senegal	***Acacia seyal***
Hyp	256	240
Asp	91	65
Thr	72	62
Ser	144	170
Glu	36	38
Pro	64	73
Gly	53	51
Ala	28	38
Cys	3	
Val	35	42
Met	2	
Ile	11	16
Leu	70	85
Tyr	13	13
Phe	30	24
His	52	51
Lys	27	18
Arg	15	11

The UV absorbance profiles differ considerably and show three peaks. Two correspond to the peaks observed by refractive index but the intensities are different. This has been shown to be due to the presence of higher concentrations of proteinaceous material in the high molecular mass fraction. The third peak corresponds to protein rich material and represents only about 1% of the total mass. This fraction has a molecular mass of ~200,000. Most structural studies have been concerned with the gum from Acacia senegal. Carbohydrate analysis has indicated that the components corresponding to the three UV absorbance peaks all have a highly branched structure consisting of a β-1,3 linked D-galactose core with extensive branching through 3- and 6- linked galactose and 3- linked arabinose. Rhamnose and glucuronic acid are positioned at the periphery of the molecules where they terminate some of the branches (Figure 3.2). The main component, (peak 1), commonly contains <1% protein. Material corresponding to peak 2, has protein content of ~10%. Since this fraction is readily degraded by proteolytic enzyme it has been reported to have a 'wattle blossom-type' structure where blocks of carbohydrate of molecular mass ~250,000 are linked to a common polypeptide chain (Figure 3.3). Material corresponding to peak 3 has a lower glucuronic acid content than the other two fractions and has a reported protein content of 20 – 50%. Since this fraction cannot be degraded by proteolytic enzyme it is believed that the proteinaceous component is located within the centre of the molecules. Whereas the predominant amino acids in fractions corresponding to peaks 1 and 2 are hydroxyproline and serine, the predominant amino acids in the fraction corresponding to peak 3 are aspartic, serine, leucine and glycine. All three fractions interact with Yariv's reagent and hence can all be classified as arabinogalactan – protein complexes (AGP's).

3.3 Physical Properties

Gum arabic readily dissolves in water to give clear solutions ranging in colour from very pale yellow to orange- brown and with a pH of ~4.5. The highly branched structure of Acacia senegal gum gives rise to compact molecules with a relatively small hydrodynamic volume and as a consequence gum solutions only become viscous at high concentrations as illustrated in Figure 3.4. A comparison of the viscosity of the gum with xanthan gum and sodium carboxymethylcellulose, which are common thickening agents, is shown in Figure 3.5. It is seen that even 30% gum arabic solutions have a lower viscosity than 1%, xanthan gum and sodium carboxymethylcellulose at low shear rates. In addition, while gum arabic is Newtonian in behaviour with viscosity being shear rate independent, both xanthan gum and sodium carboxymethyl cellulose display non-Newtonian shear thinning characteristics. This is explained by the fact that the latter are linear molecules and intermolecular entanglements can readily occur while this is not the case for the highly compact, branched gum arabic molecules. The viscosity decreases in the presence of electrolytes due to charge screening and at low pH when the carboxyl groups become undissociated.

The other major functional characteristic of gum arabic is its ability to act as an emulsifier for essential oils and flavours. It is now known that the protein - rich high molecular mass component adsorbs preferentially onto the surface of the oil droplets. It is envisaged that the hydrophobic polypeptide chains adsorb and anchor the molecules to the surface while the carbohydrate blocks inhibit flocculation and coalescence through electrostatic and steric repulsions. This is schematically illustrated in Figure 3.6. Since only part of the gum is involved in the emulsification process, the concentration required to produce an emulsion is much higher than for pure proteins. For example, in order to produce a 20% orange oil emulsion then gum arabic concentrations of ~12% are required. Once formed the emulsions can remain stable for long periods of time (several months) with no evidence of coalescence occurring.

Prolonged heating gum arabic solutions causes the proteinaceous components to precipitate out of solution thus influencing the gum’s emulsification properties.

State of research on nutritional aspects of Acacia gum and recent clinical studies

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6.1 Introduction

The objective of this presentation is to review the science base concerning the nutritional and health benefits of Acacia gum and to evaluate whether sufficient evidence exists for functional claims for Acacia gum. The topics to be addressed are as follows:
• classification of Acacia gum as dietary fibre based on its resistance to digestion followed by fermentation in the colon,
• improvement of bowel habit,
• stimulation of bifidobacteria growth to support its classification as prebiotic,
• absence of adverse symptoms making Acacia gum a very comfortable fibre,
• effects on urea recycling,
• possible increased bioavailability of minerals, in particular calcium,
• potential effects on lipid metabolism, and
• the not yet investigated influence on colon carcinogenesis.

6.2 Acacia Gum is a Soluble Dietary Fibre

Dietary fibres are defined as the remnants of plant cells which are not hydrolysed by the enzymes of the human intestine, and thus which enter into the large intestine where they can be fermented by the resident microflora. Most of the components under this definition are polysaccharides from the cell wall (cellulose, hemicelluloses and pectins) as well as from the cytoplasm (gums, resistant starch, inulin, etc.). Acacia gum consists mainly of highly branched galactan polymers, with galactose and/or arabinose side chains, possibly terminated by rhamnose or glucuronic acid residues. The human digestive tract does not secrete or express any enzyme able to hydrolyse this polysaccharide. Acacia gum therefore transits undigested through the stomach and small intestine before arriving into the colon where it is fermented by bacteria. Fermentation of acacia gum is complete since no residue is found in stools (1). Acacia gum is degraded into gases excreted during breathing (1, 2) and short-chain fatty acids (SCFA) absorbed by the colonic mucosa (2, 3, 4). This digestive fate is comparable to that of other soluble dietary fibres such as guar gum or pectins.

6.3 Acacia Gum Regulates Stool Output

Several data have suggested that Acacia gum could be a laxative as other soluble dietary fibres. These fibres improve bowel habits mainly by increasing bacterial mass and water excretion in stools. This leads to rise in faecal volume, softening of stools thus eased excretion, and more frequent bowel movements. In a recent study, ingestion of acacia gum increased stool weight by 15 to 30 %, depending on the dose, in healthy young volunteers. The faecal bulking index of acacia gum was found to be about 1.5 g of added stools per g of gum (unpublished), which is close to the indexes of other soluble fibres such as pectins (1.2 g/g), guar gum (1.3 g/g), inulin (1.5 g/g) or fructo-oligosaccharides (1.2 g/g). Likewise, it is quite plausible that the laxative effect of acacia gum would be more pronounced in slightly constipated persons. Beside its laxative properties, acacia gum may also reduce diarrhoea.

6.4 Acacia Gum is Bifidogenic

About 15 years ago, results obtained in one volunteer showed that fermentation of acacia gum increased certain faecal micro-organisms among which Bacteroides and Bifidobacterium species have been identified (6). Then, in vitro studies have highlighted the ability of acacia gum to support bifidobacterial growth (7), particularly that of Bifidobacterium longum and B. adolescentis species (8). This potential prebiotic effect of acacia gum has been confirmed both in vitro and in humans. In vitro, acacia gum promoted growth of human faecal lactic acid producing bacteria, among which were Lactobacillus and Bifidobacterium sp., similarly as short-chain fructo-oligosaccharides (9). In healthy young volunteers, the gum specifically increased Bifidobacterium sp. faecal concentrations by 175 to 300% depending on the dose (unpublished). Accordingly that has been reported with other prebiotic carbohydrates, the bifidogenic effect was superior in volunteers with low basal bifidobacteria levels.

6.5 Digestive Tolerance of Acacia Gum is High

Increasing dietary fibre intake may occasion several symptoms of digestive discomfort which could lead healthy consumers to desert the product, or which could be counter-indicated in some patients. Acacia gum is soluble, thus cannot irritate the intestine as some insoluble fibres. In addition, due to its high molecular weight, it is not osmotically active. Its malabsorption cannot thus induce osmotic diarrhoea. Moreover, its fermentation produces low level of gases as shown by the low concentration of hydrogen measured in breath of volunteers after gum ingestion. Thanks to all these particularities, acacia gum should not induce symptomatic responses of intolerance even at high doses. This hypothesis has been proved correct in human volunteers who consumed increasing dosages of either acacia gum or sucrose in a blind manner for 3 weeks. No significant differences were noticed between sucrose and acacia gum at doses below 30 g/d, which is the maximal dose expected in a normal diet (unpublished). The mean occurrence dose, defined as the first dose at which a symptom was graded constantly higher with acacia gum than with sucrose by a subject, was 53.5 ± 2.5 g/d for flatus and more than 70 g/d for other symptoms such as bloating, borborygmi, abdominal cramps, diarrhoea and nausea. In comparison, short-chain fructooligosaccharides,
which were also tested in the same subjects, were not as well tolerated and stimulated more symptoms of discomfort than Acacia gum.
At this step of the demonstration, we could state that Acacia gum is a well-tolerated, bifidogenic soluble dietary fibre which improves intestinal function. However, Acacia gum may have other potential functional or health effects, which deserve to be examined.

6.6 Acacia Gum Lowers Serum Urea Nitrogen

Fermentable dietary fibre is proposed as part of the treatment for uremic patients, to decrease the workload of the kidneys, and for cirrhotic patients, in whom the need is to lessen the workload on the liver. In both cases, acacia gum has been shown very effective in decreasing serum urea nitrogen and urine nitrogen excretion while increasing faecal excretion
 of nitrogen within biomass (10, 11). Acacia gum stimulates bacterial growth and activity. The intestinal bacteria produce ureases that hydrolyse urea to ammonia and CO2. The resultant ammonia can then be incorporated into bacterial proteins, which are subsequently excreted in the bacterial mass fraction of the stools. The net result is increased nitrogen output in the stools and less in the urine.

6.7 Acacia Gum may Enhance Calcium (and other minerals) absorption

Whereas cereal fibres are supposed to depress mineral availability, soluble fermentable fibres could improve absorption of minerals by several mechanisms. One of them, appearing as a major one, is the lowering of colonic pH, associated with extensive fermentation, which solubilizes minerals, such as calcium, magnesium, iron and zinc, thus making them available for absorption in the distal parts of the intestine. However, whereas the results have been constantly positive with calcium, they are more conflicting with other minerals in man (12). Acacia gum is likely completely fermented in the human proximal colon and should decrease luminal pH as it stimulates growth of lactic acid-producing bacteria. Consequently, it may promote absorption of calcium and possibly other minerals by the same mechanisms than other soluble fibres. Preliminary results obtained in rats indicated that caecal acid-soluble calcium was higher in acacia gum fed rats than in those fed with guar gum. Furthermore, caecal absorption rate of potassium, magnesium and calcium went up with acacia gum (13). Up to now, no information in humans has been reported.

6.8 Acacia Gum may influence Lipid Metabolism

Although most specific mechanisms involved in the metabolic effect of fibre are still under investigation, knowledge is accumulating indicating that some fibre sources, especially the viscous soluble fibre-rich, influence lipid metabolism by several concomitant means. Acacia gum, though soluble, is not viscous, thus cannot affect lipid metabolism by this way. However, fragmentary results have been reported which suggest that, despite its lack of viscosity, acacia gum may affect certain mechanisms involved in lipid metabolism. It is unlikely that acacia gum could lower plasma cholesterol in normo-cholesterolemic humans and animals (14-16). However, when rat diets were supplemented with cholesterol, acacia gum reduced liver cholesterol content and apparent cholesterol absorption (17, 18). In addition, it increased caecal pool and faecal excretion of bile acids (19). Likewise, in mild hyper-cholesterolemic humans, high doses of acacia gum (20-25 g/d) decreased cholesterolemia (1, 20). Acacia gum may also decrease plasma triglycerides. Results are sparse and contradictory. However, in rats fed a high dose gum, lower serum triacylglycerol has been described (19). This result is consistent with other reports that some soluble, nonviscous, fermentable fibres (such as fructo-oligosaccharides) would exert hypolipidemic effects in rats (21).

6.9 Acacia Gum might influence Colon Carcinogenesis

The potential protective effect of dietary fibre against colon cancer is still a matter of debate. Nevertheless, numerous experimental evidences have been accumulated indicating that further investigation of the hypothesis must not be given up. Actually, it is now clear that not all the fibres have the same potential to influence carcinogenesis and that only some of them could be effective. Among these, prebiotic fibres are currently explored. Very preliminary studies performed in animal models have demonstrated that substrates such as fructooligosaccharides or a combination of bifidobacteria with oligosaccharides reduced incidence of colon cancer, affected several markers of carcinogenesis, and prevented the formation of aberrant crypt foci in the colonic mucosa (22, 23). The means by which these effects occurred are currently under investigation. Also, the existence of such effects in humans is totally unknown. Acacia gum is a prebiotic fibre. Therefore, if the mechanisms of protection are related to this property rather than to other properties of fructo-oligosaccharides, it might exert similar effects.

Butyrate modulates TGF-beta1 generation and function: potential renal benefit for Acacia(sen)
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The aim of the study was to examine the hypothesis that dietary manipulation may increase **serum butyrate and thus have potential beneficial effects in renal disease**.

We examined the effect of dietary supplementation with a gum arabic sample of standardized molecular characteristics, Acacia(sen) SUPERGUM EM2 (SUPERGUM), on systemic levels of butyrate in normal human subjects. In an in vitro study, we also examined the potential role of butyrate in modifying the generation of the profibrotic cytokine transforming growth factor-beta (TGF-beta1) by renal epithelial cells. Following 8 weeks of dietary supplementation with 25 g/day of SUPERGUM, there was a two-fold increase in serum butyrate (n=7, P=0.03). In vitro work demonstrated that exposure of renal epithelial cells to elevated concentrations of butyrate suppressed both basal and stimulated TGF-beta1 synthesis. The action of butyrate was mediated by suppression of the extracellular signal-regulated kinase/mitogen-activated protein kinase signalling pathway. In addition, butyrate exposures reduced the response of renal epithelial cells to TGF-beta1 as assessed by luciferase activity of a TGF-beta-responsive reporter construct. Attenuation of TGF-beta1 signalling was associated with reduced phosphorylation of Smad 3 and decreased trafficking of TGF-beta1 receptors into signalling, non-lipid raft-associated membrane fractions. In conclusion, the data demonstrate that dietary supplementation with SUPERGU increased serum butyrate, which at least in vitro has beneficial effects on renal pro-fibrotic cytokine generation.

Modulation of small intestinal nitric oxide synthase by gum arabic.

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Preceding studies have revealed that gum arabic (GA), a natural proteoglycan (>/= 250,000 Da), has proabsorptive properties-as shown by increased sodium and water absorption-in normal rats, and especially in two animal models of diarrhea. Because nitric oxide (NO) metabolism is linked to gastrointestinal physiology, the goals of this study were to determine whether GA modulated NO and to determine intestinal function in vivo when NO production was enhanced by l-arginine (Arg), added at either 1 or 20 mM.

Mechanistically, the goal was also to determine whether GA was a NO scavenger and a small intestinal NO synthase (NOS) inhibitor.

Using a glucose-electrolyte solution in rat jejunal perfusions we found that GA at +/-10 microM (2.5 g/l) decreased nitrite and nitrate formation, tending to normalize water, sodium, and glucose absorption when modified by Arg addition. In vitro tests, with oxyhemoglobin as a marker, showed that GA at >/= 5 microM scavenged NO. For GA effects on NOS, small intestinal homogenate supernatants (10,000 g) from frozen tissues of either adult or 2-day-old rats were incubated for 1 hour at 37 degrees C in the presence of 2 mM Arg and increasing GA concentrations (0-100 microM). GA produced a concentration-dependent inhibition of NOS, reaching approximately 31% inhibition with 5 microM GA and up to 51% with 50 microM GA. GA at 100 microM produced no further inhibition. The data indicate that GA, in addition to its ability to remove NO diffused into the intestinal lumen, may also partially inhibit intestinal NOS and thus modulate intestinal absorption through these mechanisms. Use of GA as a food additive may help in restoring or improving small intestinal function in conditions where functional damage has occurred.

Acacia gum supplementation of a low-protein diet in children with end-stage renal disease.

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Patients with end-stage renal disease (ESRD) die in the absence of renal replacement therapy (RRT). In developing countries RRT is not uniformly available and treatment often relies on conservative management and intermittent peritoneal dialysis (IPD). This study investigates the possibility of using acacia gum supplementation to improve the quality of life and provide children with ESRD with a dialysis-free period. Three patients referred to our hospital with ESRD during a 3-month period were enrolled in a therapeutic trial to investigate the efficacy of acacia gum (1 g/kg per day in divided doses) as a complementary conservative measure aimed at improving the quality of life. Inclusion criteria included a pre-dialysis creatinine clearance of <5 ml/min, current dietary restrictions and supplementation, at least one dialysis session to control uremic symptoms, absence of life-threatening complications, and sufficient motivation to ensure compliance with the study protocol. One patient complied with the protocol for only 10 days and died after 6 months, despite IPD. Two patients completed the study. Both reported improved well-being. Neither became acidotic or uremic, and neither required dialysis during the study period. Both patients maintained urinary creatinine and urea levels not previously achieved without dialysis. In conclusion, dietary supplementation with acacia gum may be an alternative to renal replacement therapy to improve the quality of life and reduce or eliminate the need for dialysis in children with ESRD in some developing countries.

Protective effect of arabic gum against acetaminophen-induced hepatotoxicity in mice.

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Overdose of acetaminophen, a widely used analgesic drug, can result in severe hepatotoxicity and is often fatal. This study was undertaken to examine the effects of arabic gum (AG), which is commonly used in processed foods, on acetaminophen-induced hepatotoxicity in mice. Mice were given arabic gum orally (100 g l(-1)) 5 days before a hepatotoxic dose of acetaminophen (500 mg kg(-1)) intraperitoneally. Arabic gum administration dramatically reduced acetaminophen-induced hepatotoxicity as evidenced by reduced serum alanine (ALT) and aspartate aminotransferase (AST) activities. Acetaminophen-induced hepatic lipid peroxidation was reduced significantly by arabic gum pretreatment. The protection offered by arabic gum does not appear to be caused by a decrease in the formation of toxic acetaminophen metabolites, which consumes glutathione, because arabic gum did not alter acetaminophen-induced hepatic glutathione depletion. Acetaminophen increased nitric oxide synthesis as measured by serum nitrate plus nitrite at 4 and 6 h after administration and arabic gum pretreatment significantly reduced their formation. In conclusion, arabic gum is effective in protecting mice against acetaminophen-induced hepatotoxicity. This protection may involve the reduction of oxidative stress.