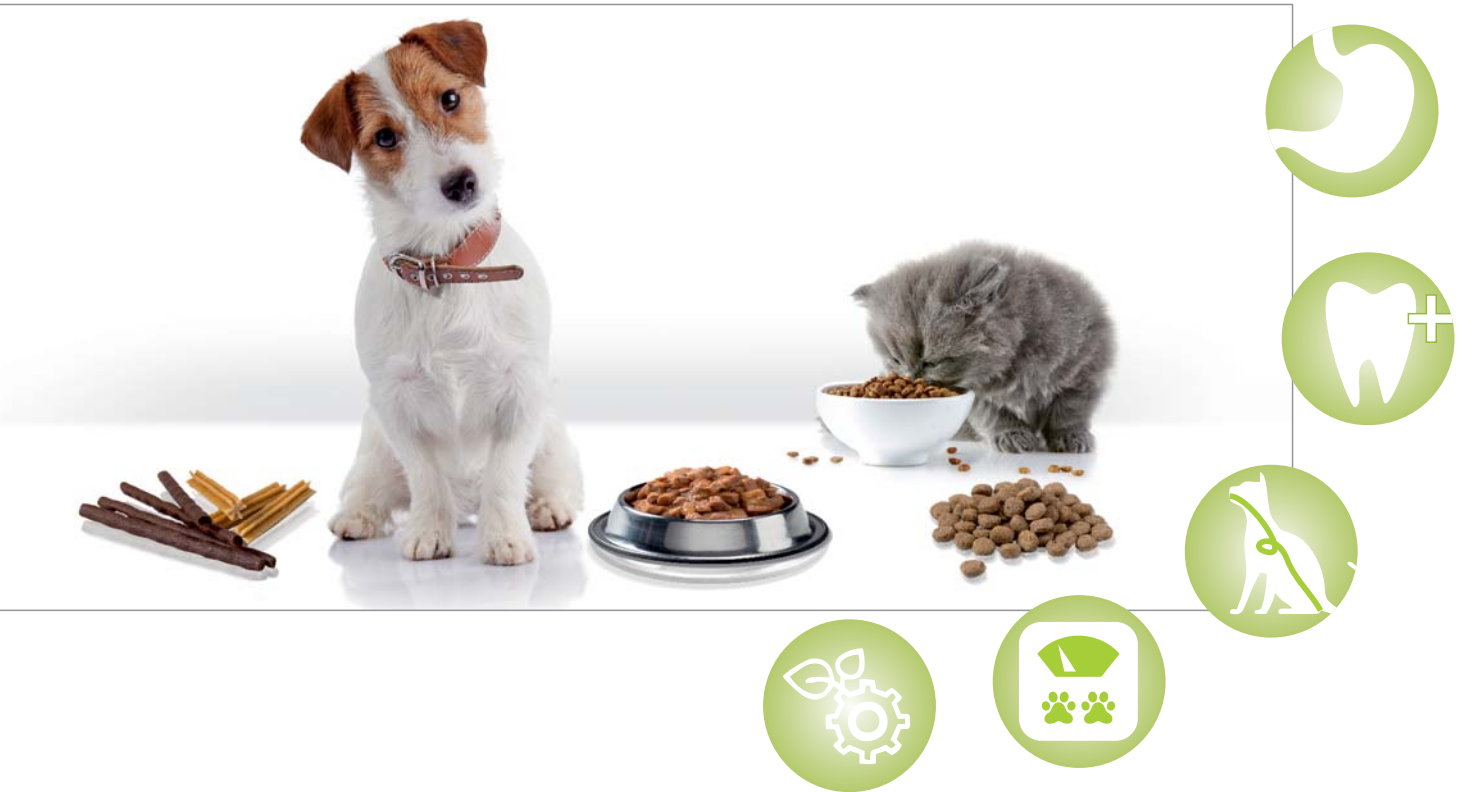


# ARBOCEL®

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Adding Value in Pet Foods with  
High Quality Dietary Fiber Ingredients

J. RETTENMAIER & SÖHNE  
GMBH + CO KG



Fibers designed  
by Nature



**ARBOCEL®**

Crude Fiber Concentrate

## ARBOCEL® – Nutritional, Sustainable Pet Food Ingredients



At JRS, we've been making high-quality fiber ingredients for humans and pets for more than 60 years. Today, we are a global expert in animal nutrition solutions that are natural, healthy and sustainable. Our long history producing high-quality and nutritious fiber ingredients has provided an edge in producing premium natural ingredients that pet food manufacturers can trust. The entire process from harvest, storage and final production is done under controlled conditions in order to guarantee a complete product integrity and traceability. **ARBOCEL®** fiber products are produced from all-natural, renewable and domestically grown plant sources based on Lignocellulose and Cellulose that will raise the quality of your product, while also improving your sustainability performance.

### Your Advantage – ARBOCEL® Pet Food Fibers

- Safe, all-natural fiber ingredients
- Fully traceable & compliant
- Add sustainability to reduce our pet's carbon paw print
- Consistent quality
- Wide range of choices for all pet food categories
- Beneficial through all stages of our pets life
- Outstanding nutritional expertise & experience



## Your Competitive Advantage – Finest Fiber Ingredients for Pet Foods

Unlike many traditional fiber sources, our non-GMO fiber ingredients are unaffected by seasonal fluctuations, the availability of food products, any geographic variability or unwanted shifts in quality. As a concentrate, our **ARBOCEL®** Crude Fiber Concentrates (CFCs) comprise a minimum of 70 % crude fiber. This is up to four-fold higher than the fiber content of traditional sources made from by-products.

### Highest content of crude fiber

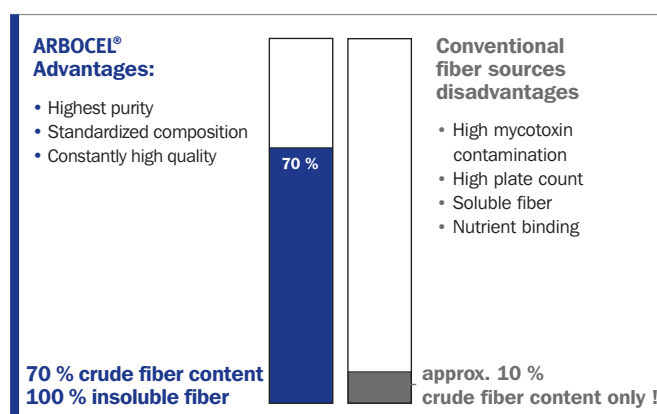


Fig. 1 A concentrated source of fiber like **ARBOCEL®** Cellulose works most efficient as it provides a minimum of 70 % crude fiber – this is more than any other conventional fiber source

Moreover, **ARBOCEL®** fiber ingredients are produced with a special milling technology – High Pressure Centrifugal (HPC) Fibrillation which produces refined fibers. These extremely soft and thin particles are the key for the physiological and quality effects of our HPC fibrillated fibers.

### Your advantage – maximum fiber power !

Not all dietary fiber sources are created equal !

**ARBOCEL®** crude fiber concentrates from JRS possess incomparable characteristics due to the unique HPC-fibrillated fiber, which absorbs significantly more water than non-fibrillated fibers. Moisture is immediately assimilated into the fiber and can be resorbed further down in the hindgut of the animal.

### Your commanding lead – special JRS process engineering !



With its HPC-fibrillation from plant fibers, JRS holds a technological lead in the market that assures you a competitive edge. The specifically developed unique milling technology unlocks the maximum water binding effect of the crude fiber concentrate – aimed at pioneering usage in balanced and functional pet foods.

### What happens during HPC-fibrillation ?

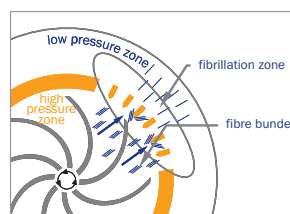
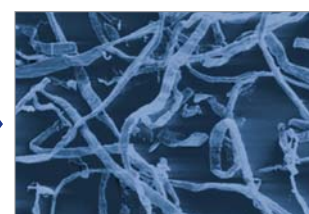


Fig. 2 HPC-fibrillation, systematic process view



Pic. 1 **ARBOCEL®** HPC fibrillated fiber network, scale: 100-times magnified (macro image)

In a multi-stage processing step, the fiber structure is broken down into its finest fibrillate structure by subjecting the fibers to external air pressure.

## Digestive Care & Stool Quality



For pet owners, feces consistency and volume are good indicators of intestinal health and food quality: well formed stools that are not too moist or loose and not too dry or hard are much easier to pick up. Firmer good quality stools with reduced odor are especially important to pet owners living in urban areas as they routinely pick up their dog's droppings in a bag, or flush their cat's waste down the toilet.

### Effect of ARBOCEL® for Better Stool Quality

Wichert et al. (2002) fed dogs on an essentially fiber-free, wet diet consisting of cooked greaves, cooked starch, sunflower oil and a mineral-vitamin supplement. On the fiber-free diet (control), the dogs' feces had a liquid/pasty appearance (Figure 3). The feces became solid and well formed when **ARBOCEL®** with a fiber length of 200 – 300 µm was added to the fiber-free diet at 10 % of the dietary dry matter. The beneficial effect of **ARBOCEL®** was associated with an increase in the dry matter content of feces from about 28 to 32 %.

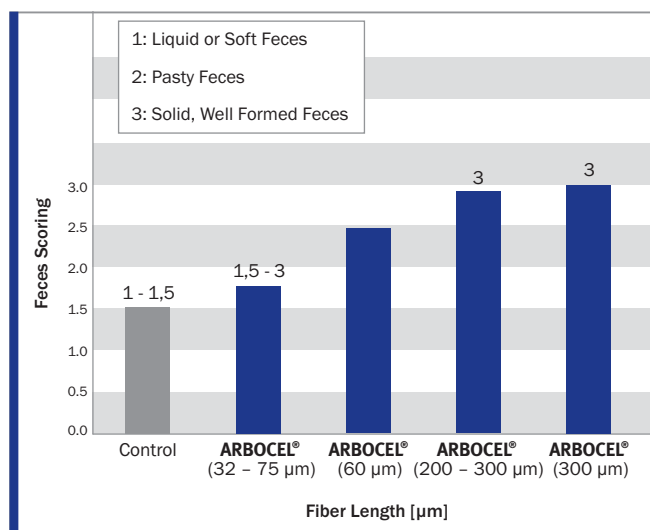


Fig. 3 Fecal Scoring Trial (Wichert et al., 2002)



## Effect of **ARBOCEL**® for Enhanced Nutrient Digestibility



Exclusive Fiber System to maintain healthy digestion in pets

It has been demonstrated in three independent university trials that feeding **ARBOCEL**® Lignocellulose versus wheat bran or beet pulp increased the apparent dry matter digestibility by up to 4.2 % units (Table 1).

Experiment 1 - Germany		Wheat bran	<b>ARBOCEL</b> ®
Dry matter		84.2	86.5
Experiment 2 - India		Wheat bran	<b>ARBOCEL</b> ®
Dry matter		65.3	69.5
Crude protein		69.6	77.9
Crude fat		93.9	97.0
Carbohydrates		67.4	74.3
Experiment 3 - Germany		Beet pulp	<b>ARBOCEL</b> ®
Organic matter		86.7	90.4
Crude protein		82.5	85.7
Crude fat		97.6	97.7

Tab. 1 Influence of **ARBOCEL**® on group-mean apparent digestibility of dry matter and macronutrients in dogs. Within experiments, the dry foods contained similar amounts of crude fiber.

When feeding dry foods to dogs with similar content of crude fiber, the intake of **ARBOCEL**® instead of wheat bran or beet pulp reduced fresh feces output in dogs. The decrease ranged from 12 to 44 % (Figure 4).

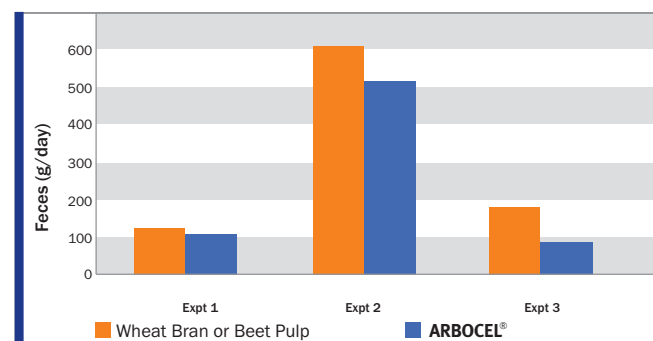


Fig. 4 Influence of **ARBOCEL**® on daily output of fresh feces (g/day) by dogs.

### Mode of action

Unlike many soluble, highly fermentable and viscous forming fibers, the **ARBOCEL**® is an insoluble fiber being resistant to fermentation by the pet's intestinal flora. Due to the fact that water is bound and released in the pet's hindgut when the **ARBOCEL**® fiber network is exposed to osmotic pressure, the intestinal water is not pulled back into the lumen and does not end up in the feces. In addition **ARBOCEL**® may lower the risk

of common side effects such as bloatings, cramping, and flatulence compared to fermentable fiber sources such as beta-glucans, pectins, sugar beet pulp or guar gum. These effects in combination with a higher digestibility of dietary dry matter explains why **ARBOCEL**®, when compared with certain viscous/gel forming fibers, reduces fecal bulk and helps to improve our pet's stool quality.

## Dental Health



Oral health is one of the top three concerns for companion animal owners, according to the American Veterinary Association (AVMA). Approximately 75 % of all cats and dogs develop some form of oral health problem by the time they're three years old. The impact of dental disease on the overall health status of the animal is not to be underestimated. Infections of the mouth can spread to other parts of the body and may even affect a pet's heart, liver and kidneys.

### Effect of ARBOCEL® for Improved Dental Care

The texture, size and shape of pet food kibbles or treats are most important for effective mechanical cleansing and to control the formation of dental plaque, calculus and gingivitis in pets. Special dental foods must possess properties that promote chewing, resist crumbling and maintain contact with the tooth surface of the pet

**HPC-Fiber Technology creates strong kibbles that stay in contact with the tooth without breaking into crumbs.**

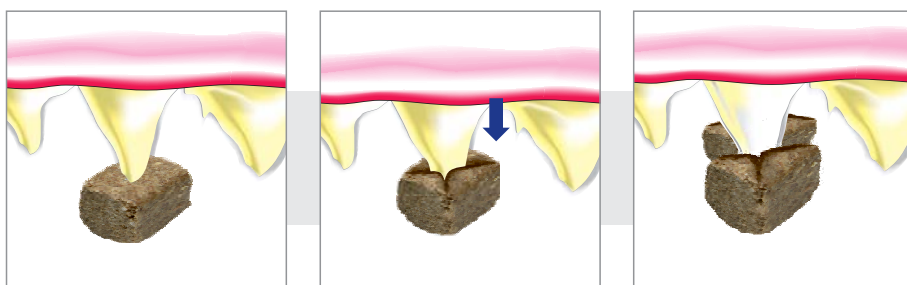


Fig. 5 Mechanical dental cleansing effect with fiber-enforced dry kibbles

(Figure 5). The desired strong texture of a dental food or chew treat can be achieved by the addition of fibrillated **ARBOCEL®** fibers that form a tight network in extruded products (Picture 2). Such foods exercise the gums and stimulate gingival blood circulation. More chewing also enhances the production of saliva which has antimicrobial activity.



Pic. 2 Unique **ARBOCEL®** fiber matrix for enhanced texture and reduced crumbling in pet foods.

## Effect of **ARBOCEL®** for Improved Dental Care



Clinical studies proved that such fiber-enhanced dental foods work more effective to promote oral health in dogs when compared with the fiber-free control product.

The incorporation of **ARBOCEL®** into an extruded chew treat for dogs has been shown to increase elasticity and chewing time. The same test treat with **ARBOCEL®** reduced signs of periodontal disease when compared with the control treat (Figure 6). The test snack was made by adding 4 % of **ARBOCEL®** BWW40 to the grain-based control formula.

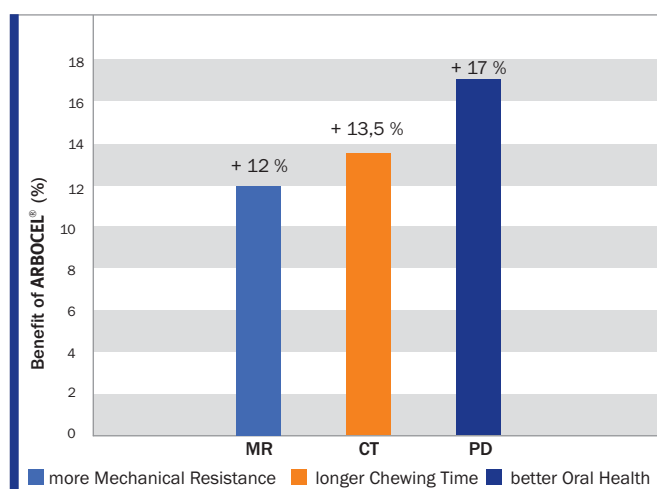


Fig. 6 Beneficial effects of **ARBOCEL®** expressed as percentage difference ( $P < 0.05$ ) versus the values for the control treat without **ARBOCEL®** – Rajamangala University of Technology Isan, Thailand, Beynen et al. 2011

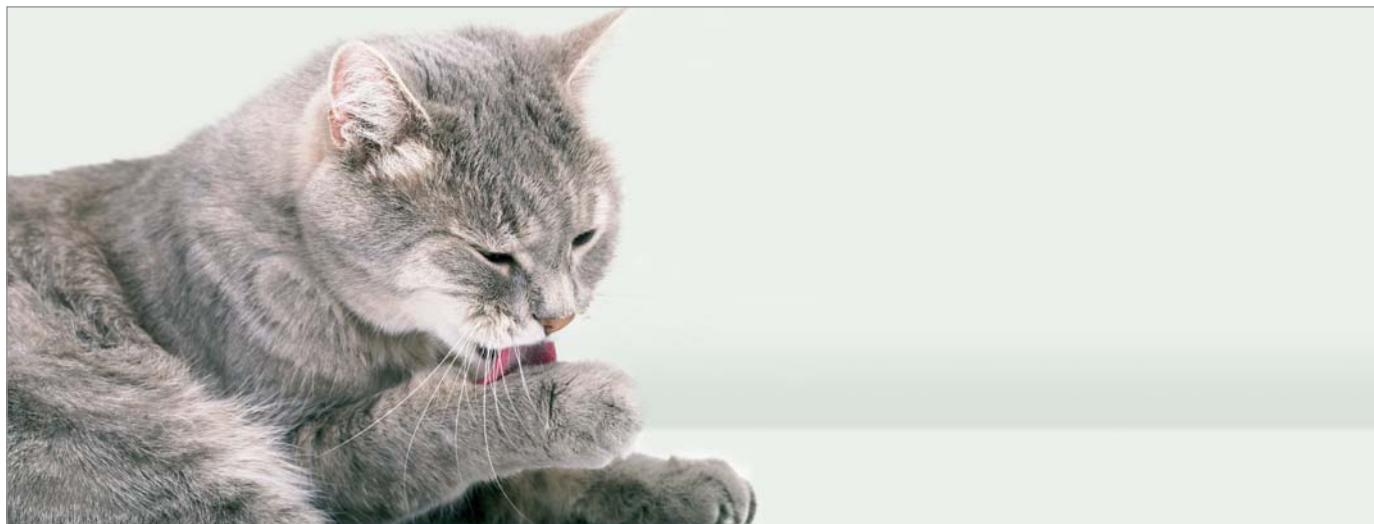
### Mode of action

The addition of **ARBOCEL®** to dental foods and treats leads to a more resistant and elastic texture, which promotes chewing in pets'. Such products with fiber-enhanced textural characteristics intensify the contact with the pets' tooth surface, thereby providing more effective mechanical cleansing. Clinical trials proved that the addition of 4 % **ARBOCEL®** Cellulose to a dental chew had reduced the formation of dental plaque, calculus and gingivitis more effectively when compared with the control treat. Consequently, **ARBOCEL®** proved to support oral health in pets. This results in improvement of oral health in dogs.



Pic. 3: Measurement of Mechanical Resistance in a Dental Chew - Three Point Bend Test (Stable Micro Systems)

## Feline Hairball Care



Hairballs are the unsavory by-product of a normal habit with our cats to groom their coats and to swallow a lot of loose hair. While most of the swallowed hair eventually passes through the animal's digestive tract and gets normally excreted with the feces, some of it remains in the stomach and gradually accumulates into a damp clump, the hairball. In some instances, such aggregates of hair may reach a size that cannot enter the duodenum and the cat needs to reject the hairball by vomiting. Long-haired breeds may be at greater risk of developing hairballs than are short-haired breeds. The most common clinical signs associated with the issue of hairball formation in cats are vomiting, retching and coughing presenting an unpleasant nuisance for many owners.

### Effect of ARBOCEL® for Feline Hairball Control

Privately owned cats with signs of gastric hairballs were enrolled in a double-blind, placebo-controlled trial with parallel design (Beynen et al., 2011). For a period of four weeks, the cats (12 per treatment group) consumed a complete dry food without or with 4 % **ARBOCEL®**. The control diet contained 1.8 % crude fiber. To formulate the test diet, 4 % of the corn component of the control diet was replaced by the same amount of **ARBOCEL®** fiber with mean fiber length of 200 µm. In a

booklet with instructions, the owners recorded each day the occurrence of hairball symptoms. The total incidence of symptoms was calculated as the number of events per treatment group per 28 days. Feeding the test diet with **ARBOCEL®** lowered the incidence of vomiting, retching and coughing by 79, 91 and 70 %, respectively (Figure 7). The **ARBOCEL®** induced a decrease in vomiting that was statistically significant.

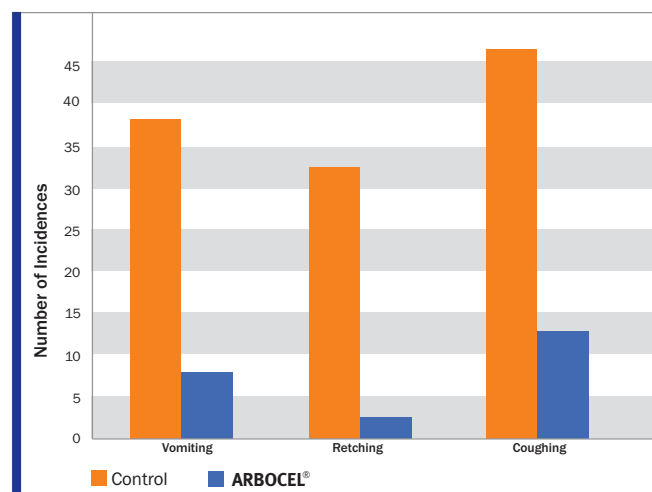
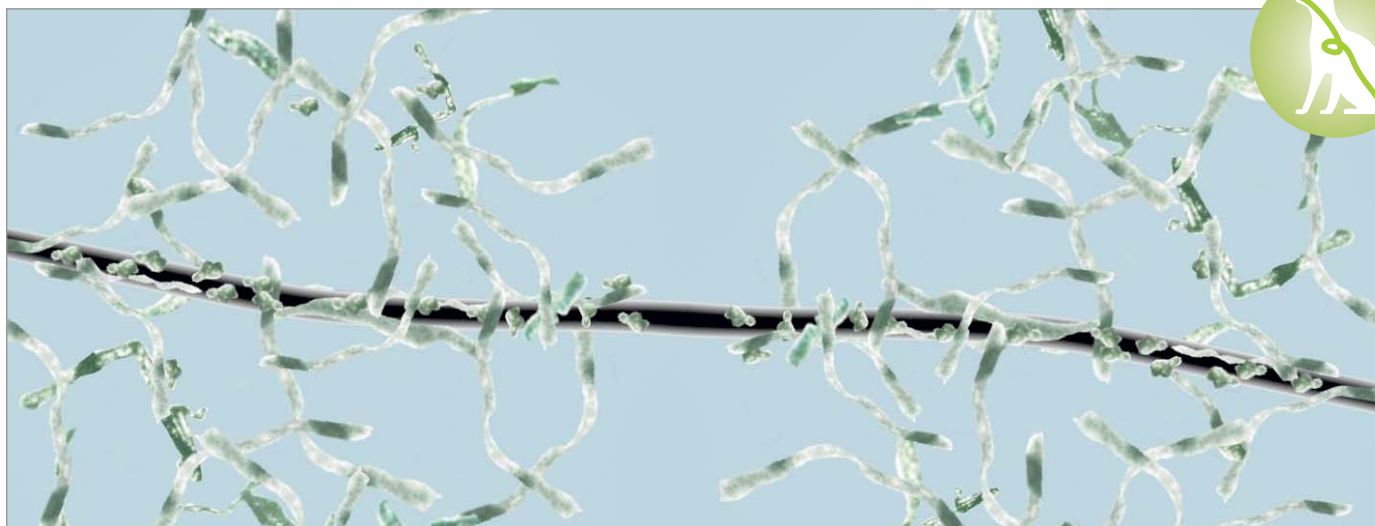


Fig. 7 Incidence of hairball symptoms expressed as total number per group for 4 weeks. Rajamangala University of Technology Isan, Thailand, Beynen et al. 2011



## Effect of **ARBOCEL**® for Hairball Control



Unique Fiber Network – Traps Ingested Hair to Avoid Hairball Formation

Baucells and Villaverde (2011) have reported on a cross-over trial with periods of three weeks each in which faecal hair excretion was determined for 20 cats consuming a commercial diet with 2 % added fibrillated **ARBOCEL**® or 2.5 % beet pulp. When the cats were fed the **ARBOCEL**® diet instead of the beet-pulp diet, faecal hair content was 15 % higher, the increase being statistically significant (Figure 8).

### Mode of action

The anti-hairball effect of **ARBOCEL**® proved to be specific when compared with soluble and non fibrillated fibers sources such as beet pulp or sugar-cane fiber. Fibrillated **ARBOCEL**® fibers facilitate the formation of an insoluble fiber network and prevent the agglomeration of single strands of hair in the cats stomach, thereby increasing the transfer of loose hairs into the duodenum. Moreover, insoluble fibers based on fibrillated Ligno-/Cellulose accelerate the transit of the digesta and thus propels duodenal hair into the feces. Together, these two mechanisms lead to the observed **ARBOCEL**®-induced fecal hair excretion. Consequently, there will be less vomiting of hairballs.

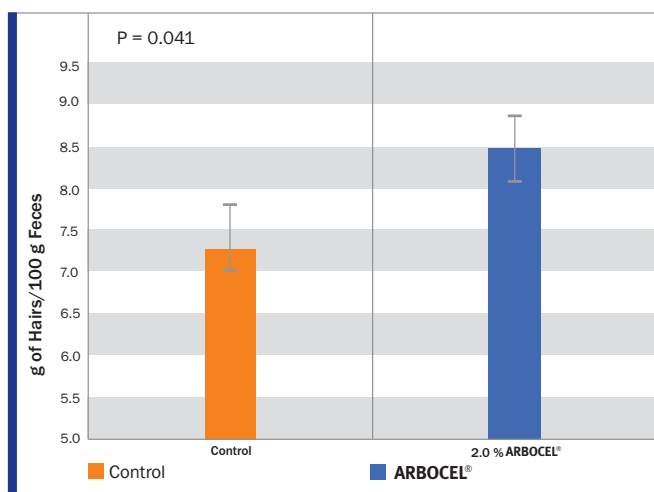


Fig. 8 Amount of hair excreted with the feces, expressed in gram of hair per 100 gram of feces. University of Barcelona, Spain, Baucells, M.D., Villaverde, C. 2011

## Fiber Enrichment for Weight Management



Like in humans, pet obesity numbers continue to increase each year. According to the Association for Pet Obesity Prevention (APOP) nearly 59 % of cats and 54 % of dogs in the US are overweight or obese. Some of the common disorders associated with the excess weight include diabetes mellitus, heart and respiratory disease, osteoarthritis, and even some forms of cancer. This situation forms the basis in developing proper nutritional solutions to better control weight with our pets.

### ARBOCEL® in Weight Management Foods

Extra dietary fiber is often added to light pet foods that are specifically designed for weight maintenance and marketed towards overweight-prone cats and dogs. The amount of calories in such fiber-enhanced light foods is typically 15 % lower than that in conventional pet foods. In this case the efficiency of the fiber source is critical for formulation. For example, a commercial diet for weight-reduction with a crude fiber content of 20 % would need much greater amounts of fiber ingredients such as beet pulp to achieve the same results as with **ARBOCEL®** (Figure 9).

### ARBOCEL® Crude Fiber Concentrates – The perfect choice for fiber-enhanced light foods

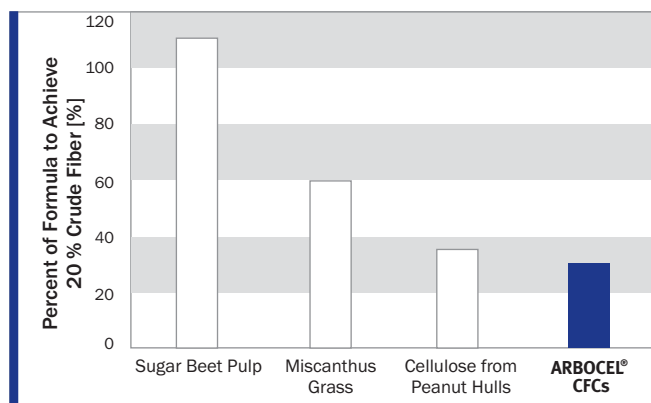
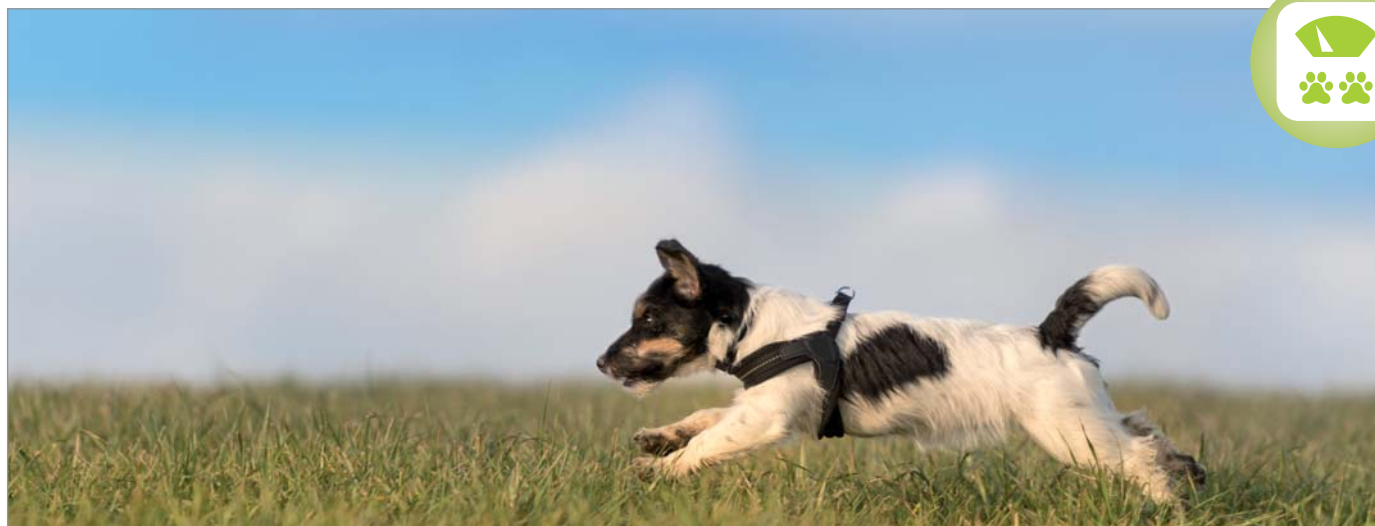


Fig. 9 A concentrated source of fiber like **ARBOCEL®** Cellulose works most efficient as it provides a minimum of 70 % crude fiber – this is more than any other conventional fiber source

## Effect of **ARBOCEL**® to Support More Effective Weight Management



**ARBOCEL**® the HPC-fibrillated crude fiber concentrate with highest water holding and swelling capacity (Figure 10/11):

**High Swelling: Water holding capacity 1:8 !**

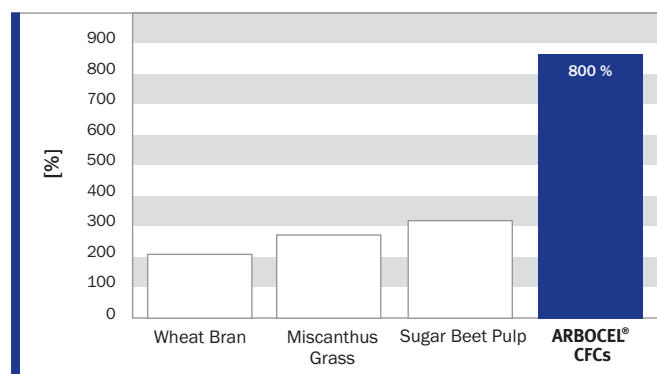


Fig. 10 Water holding capacity of selected soluble and insoluble dietary fiber sources determined by AACC (JRS, 2016)

Fast swelling in water is one of the important fundamental properties of **ARBOCEL**® HPC-fibrillated Lignocellulose and Cellulose fibers, and is also a factor in choosing the proper fiber for a specific application in pet foods. A simple experimental method for measuring swelling capacities of **ARBOCEL**® and other conventional fibers is demonstrated in Figure 11.

**The maximum water absorption is reached in less than 1 minute !**



Fig. 11 Test for swelling capacity of HPC-fibrillated Lignocellulose in water (JRS, 2012)

### Mode of Action

Using a concentrated fiber source like **ARBOCEL**® is useful in reducing and preventing obesity in pets. **ARBOCEL**® as non-fermentable, fast swelling fiber proved to increase bulk and promote a feeling of satiety without adding extra calories. The pet eats a satisfying meal, but consumes fewer calories and thus loses

weight. If rapidly fermented fiber sources such as pectin or beet pulp are used at too high of a level, then loose stools up to the point of diarrhea or excessive gas formation may result. In this case special care should be taken in choosing the right type of fiber when formulating weight management pet foods.



## JRS Product Platform and Pet Food Application



Specially formulated nutritional and functional pet food ingredients are often the key to successful development of complete foods, treats, and supplement products. As a leader in functional fiber ingredients, JRS offers a comprehensive product platform with plant-based dietary fibers. We offer products specially designed for the full range of manufacturing processes and formulation options our customers use to create products with distinct points of differentiation.



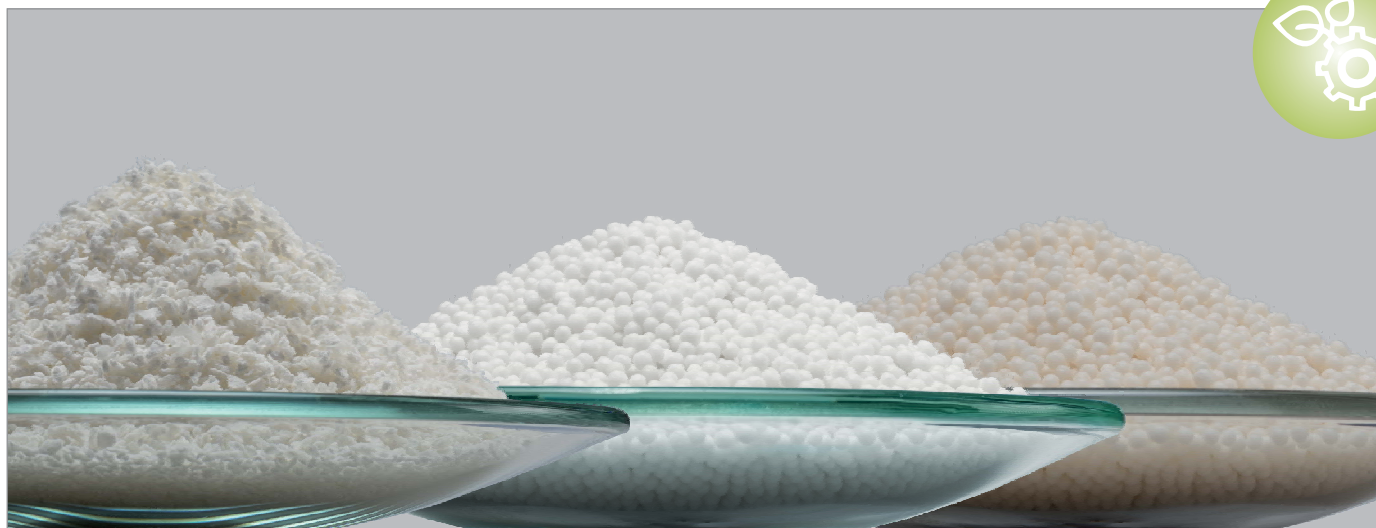
### ARBOCEL® – Beneficial Through All Pet Food Applications:

	ARBOCEL® Lignocellulose			ARBOCEL® Cellulose			VIVAPUR® MCC	VIVAPUR® MCG	ARBOCEL® DENTAL	
	R-Type	RC-Type	RC-Fine Type	B 600 - Type	BWW 40 - Type	BWW 40 C - Fine Type	BWW 40 C Extra Fine - Type	FIF 400 - Type	Microcrystalline Cellulose	Microcrystalline Cellulose Gel
<b>PET FOOD Applications</b>										
Extruded Products		●	●	●	●	●	●			●
Baked Products	●		●	●	●			●		●
Semimoist Products				●				●		●
Injection Molded Products				●	●					●
Dry Mixes/Powders	●			●			●			
Compressed Tablets	●			●					●	●
High Fat Liquids/Emulsions										●
Low Fat Liquids/Milk										●
Gravies										●

Tab. 2 ● Pelleted Ligno-/Cellulose requires pre-grinding to prevent segregation during mixing and for transport prior to extrusion



## Innovation Unleashed: Dental Pearls & Flakes



### Innovative Ingredients for Modern Oral Health Foods

JRS is consolidating its position as one of the top innovators with fiber-based ingredients in pet foods, launching several new oral care products across different life science categories. Most recently we have expanded our popular line of functional MicroCrystal-lineCellulose (MCC) fibers by launching the complete new product line of MCC Pearls & Flakes for pet foods.

For pet owners it is very difficult to decide which dental foods in the marketplace provide a significant dental benefit. Foods might make some type of oral health claim with inadequate or no research to substantiate their efficacy. The unique shape, size and hardness of MCC Pearls & Flakes provides complete new opportunities to promote a dental claim with functional pet foods and treats more effectively. Our products are specially designed to make Dental Care products looking more appealing to consumers allowing our partners to develop market winning products.

### Benefits of MCC Pearls & Flakes in pet foods:

- Differentiation on shelf to support (dental) claims through more ingredient visibility
- Possible combination with various other functional ingredients (e.g. STPP)
- High shear resistance during processing for little breakage & losses
- Inclusion of functional ingredients for less complexity in production
- Innovative ingredients for Advanced Oral Care Products

## ARBOCEL® Your Advantage in Pet Food – Scientifically Proven

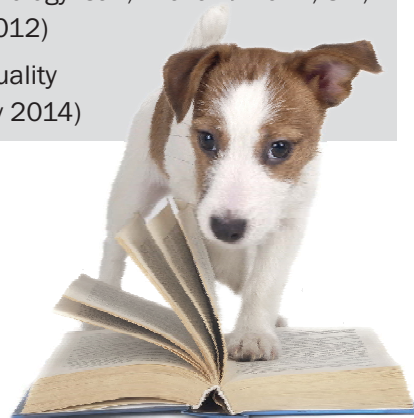


At JRS we aren't just a fiber manufacturer, we provide functional products for the care and well-being of our pets. **ARBOCEL®** provides various benefits beyond basic nutrition. Our products have been proven to be healthy for cats and dogs \_ from gut health to dental health.



### Strong Claims to Differentiate Your Brand !

- Feline Hairball Control  
(HAS Den Bosch, Netherlands 2011; UAB, Spain 2011)
- Improves Dental Care  
(VHL, Netherlands 2010; University of Technology Isan, Thailand 2011)
- Supports Satiety  
(UR Wageningen, Netherlands 2012)
- Improves Digestion & Reduces Fecal Bulk  
(LMU Munich, Germany 2007; FU Berlin, Germany 2009; Provimi Animal Nutrition, India 2012)
- Optimum Feces Quality  
(LMU Munich, Germany 2002)
- Texture Enhancement & Breakage Reduction  
(University of Technology Isan, Thailand 2011; SFI, United Kingdom 2012)
- Improves Kibble Quality  
(HS-OWL, Germany 2014)



## Contact Us



To find out more about our functional fiber ingredients for pet nutrition, please contact your nearest JRS sales representative:

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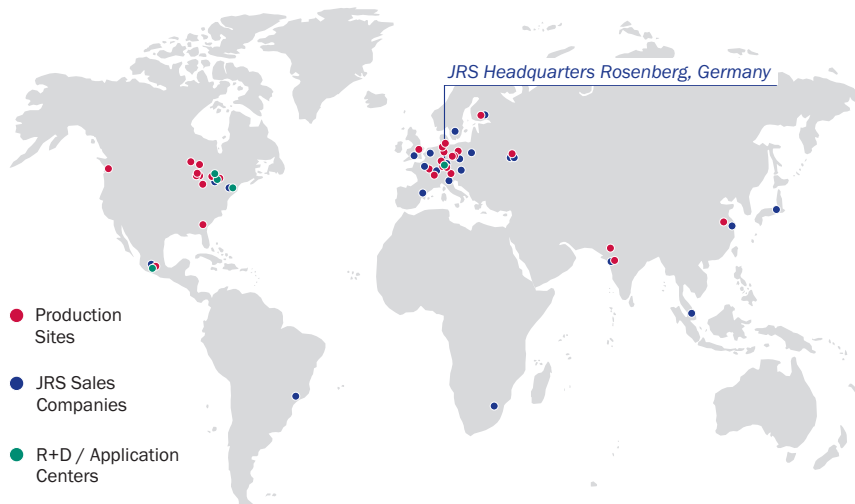


BUSINESS UNIT

## ANIMAL NUTRITION

Innovative, functional crude fiber concentrates for all species of animals.  
JRS – Your strong system partner and solution provider.

### JRS – Your Qualified Partner Worldwide



Worldwide logistics and presence

High availability and efficient, high-capacity production

In-house research and development, application services

Over 250 technical representatives around the world

Decades of experience and comprehensive application know-how

Quality manufacturing according to ISO 9001

### Global Presence

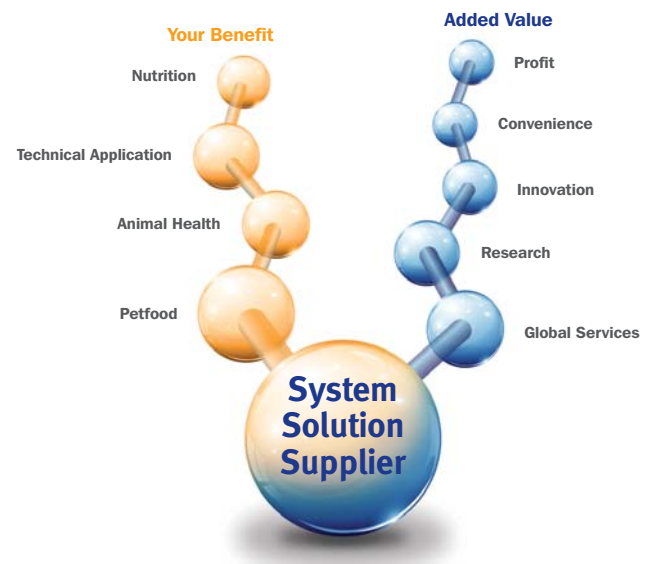
#### JRS – Your Qualified Partner Worldwide

JRS is the global market leader in Dietary Fiber products in the field of Life Science applications. We provide high performance bio-based products made from renewable resources and applied in global markets such as human foods, pharmaceuticals, home & personal care, livestock feeds, and pet foods.

For more information: [www.crudefiberconcentrate.com](http://www.crudefiberconcentrate.com)

### Why JRS ?

- Consistent high quality standards
- Over 60 years of experience
- Global presence, efficient and secure supply chain
- Advanced technology



**J. RETTENMAIER & SÖHNE**  
GMBH + CO KG



Fibers designed  
by Nature

[www.crudefiberconcentrate.com](http://www.crudefiberconcentrate.com)

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