



**ПОЛИТЕХ**

Санкт-Петербургский  
политехнический университет  
Петра Великого

Graduate School of Biotechnology  
and Food Science

Department of Technology and  
Organization of Nutrition

**FUNCTIONAL AND TECHNOLOGICAL  
PROPERTIES OF OAT GRAIN  
AND A LINE OF PROMISING FOOD  
PRODUCTS ON ITS BASIS**

**V.S. Popov, N.V. Barsukova, S.S. Sergeyeva, V.N. Krasilnikov**

Saint-Petersburg, 2016 г.

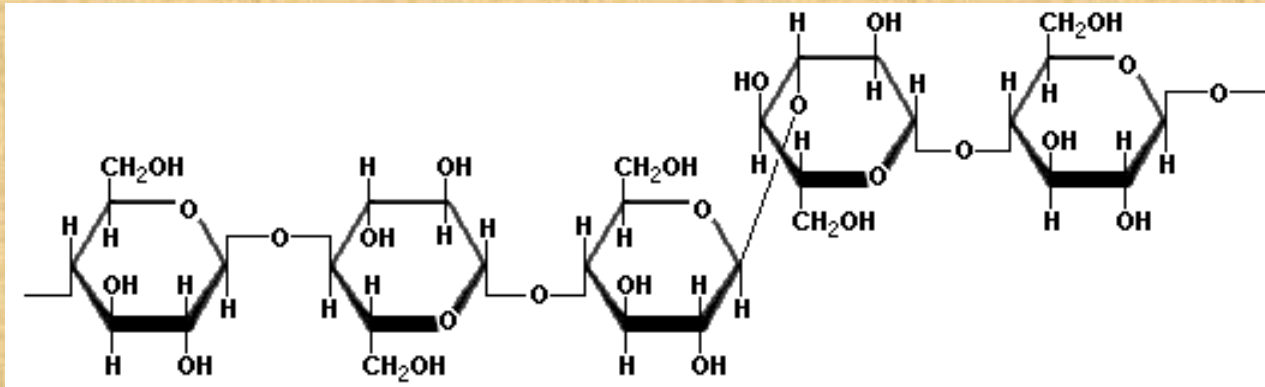
Cultivated oat (*Avena sativa*) is an undemanding to climate and soil, moisture-loving plant with a comparatively short vegetation period.



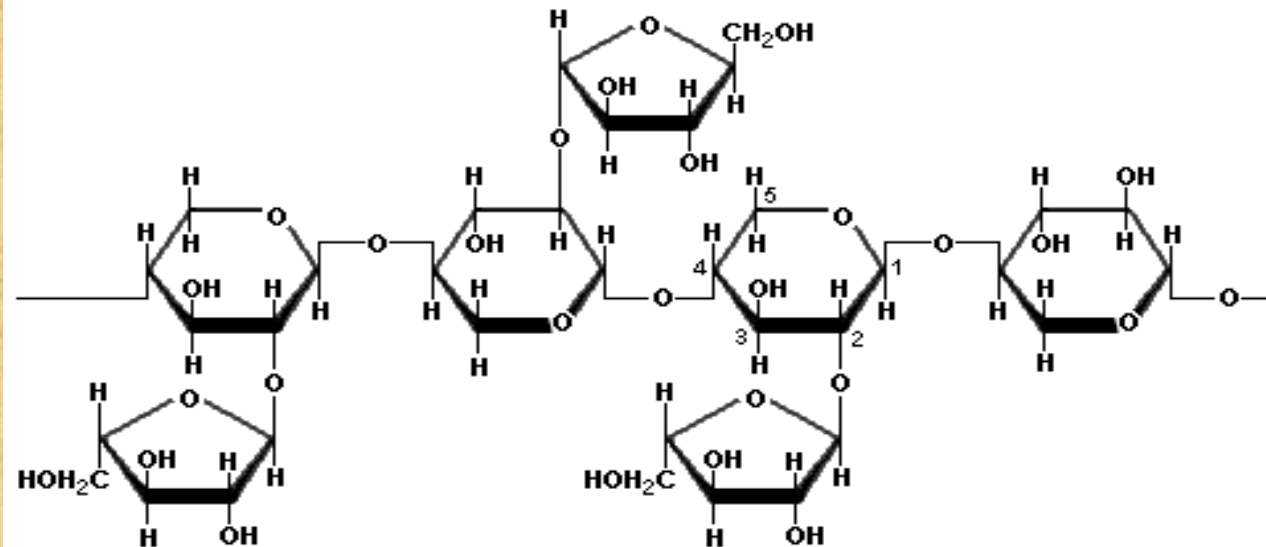
Epidemiological studies have shown that the consumption of products from whole grain oats rich in beta-glucans and arabinoxylans, protects against cardiovascular diseases, type II diabetes, obesity, certain kinds of cancer. In some countries, e.g., in Finland, the United Kingdom and the USA, oats have long been used in gluten-free diets.



## Beta-glucan



## Arabinoxylan



**Husked oat**



**Naked oat**



In comparison with the husked oats, naked oat cultivars differ by high yield and nutritional value.



Fig. 1 Naked oat in soft shell (left) and without it (right)

## **Aims of research**

- 1) studying the technological properties of the national naked oat cultivars;
- 2) development the technology and recipes of specialized and functional products on its base.

## **The objects of research**

- New and commercially cultivated naked oat cultivars;
- Oat flour produced from naked oat grain.

## **Methods of research**

- The content of  $\beta$ -glucans – AACC Method 32-23;
- The content of arabinoxylans and prolamin – infrared reflectance spectra using OMNIC software (Sigma Biological Sample Library);
- The composition of prolamins – the acid-polyacrylamide gel electrophoresis.
- Structural and mechanical properties of the dough – structure analyzer “Structurometr-ST-2”

Table 1. The content of  $\beta$ -glucans and arabinoxylans in different cereal crops <sup>(a)</sup>

Cereal crops	$\beta$ -glucans, %	Arabinoxylans, %
<b>Wheat</b>	<b>0,7</b>	<b>6,7</b>
<b>Rye</b>	<b>1,9</b>	<b>8,5</b>
<b>Barley</b>	<b>4,4</b>	<b>6,1</b>
<b>Oat <sup>(B)</sup></b>	<b>3,4</b>	<b>6,4</b>

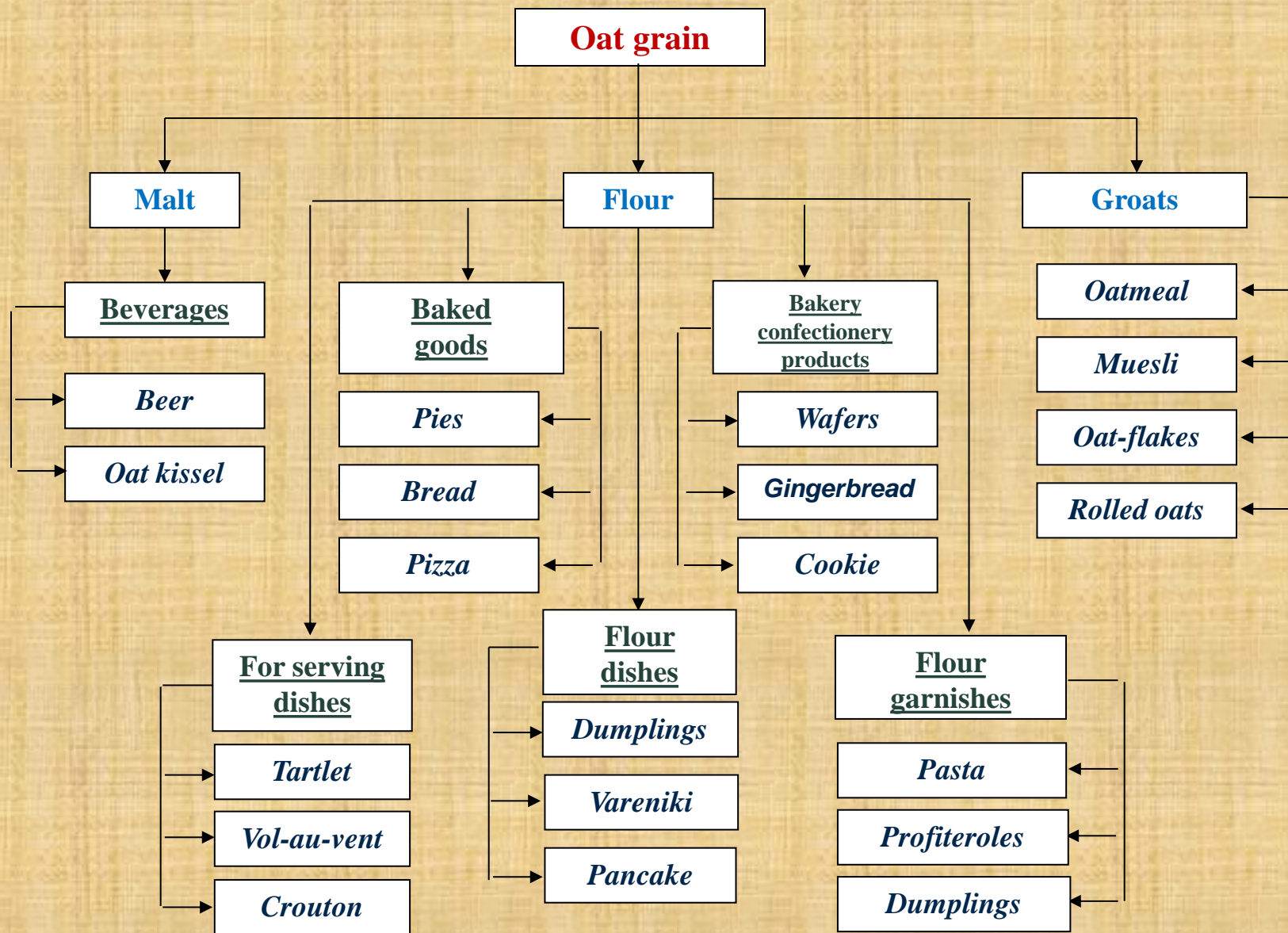
<sup>(a)</sup> P.Aman, K.Hesselman, Analysis of starch and other main constituents of cereal grains, Swedish J.Agr.Res., 14, pp.135-139, 1984.

<sup>(B)</sup> own data



# Oat Food Products



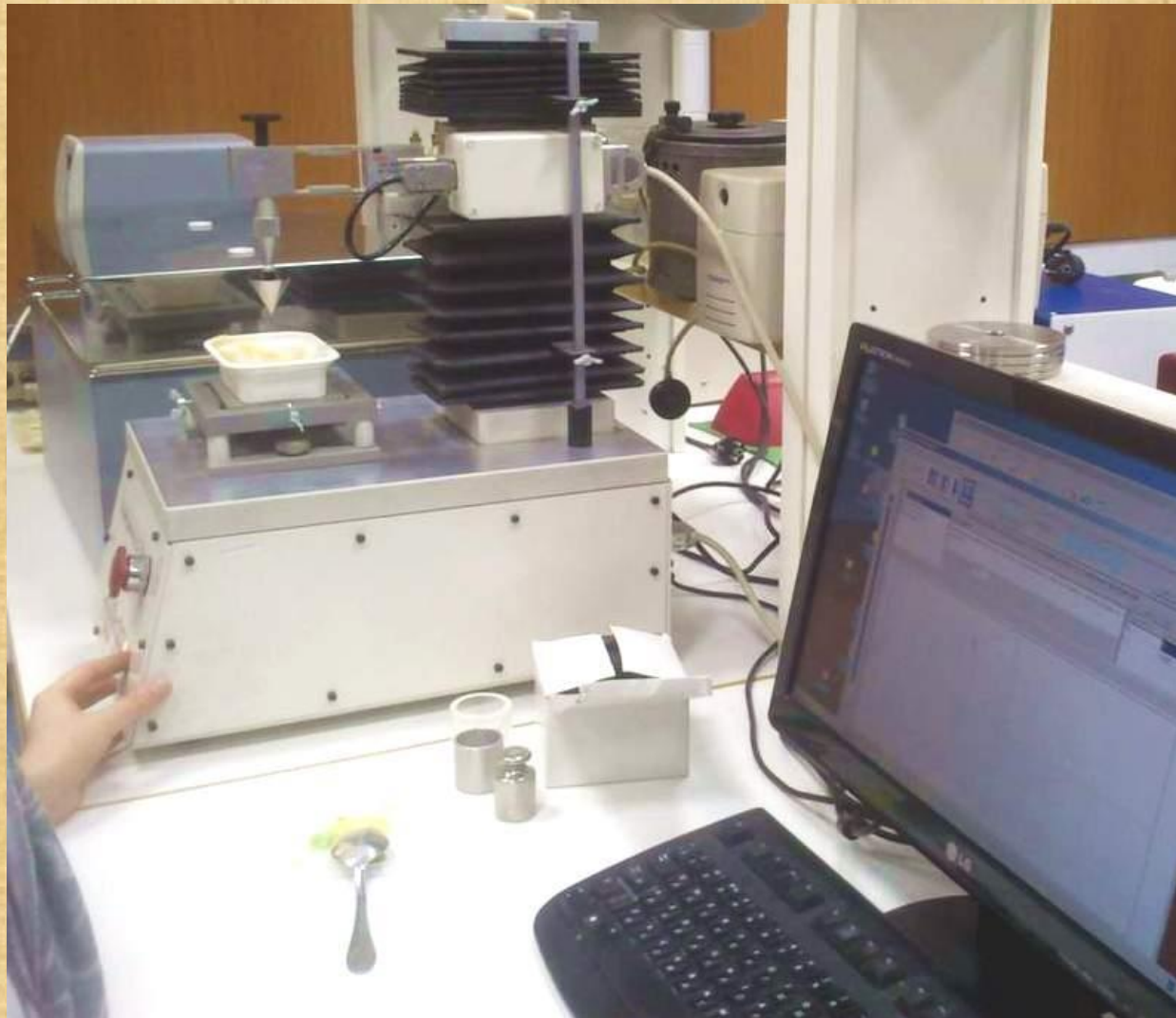


**Fig. 2. Classification of oat food and beverages**

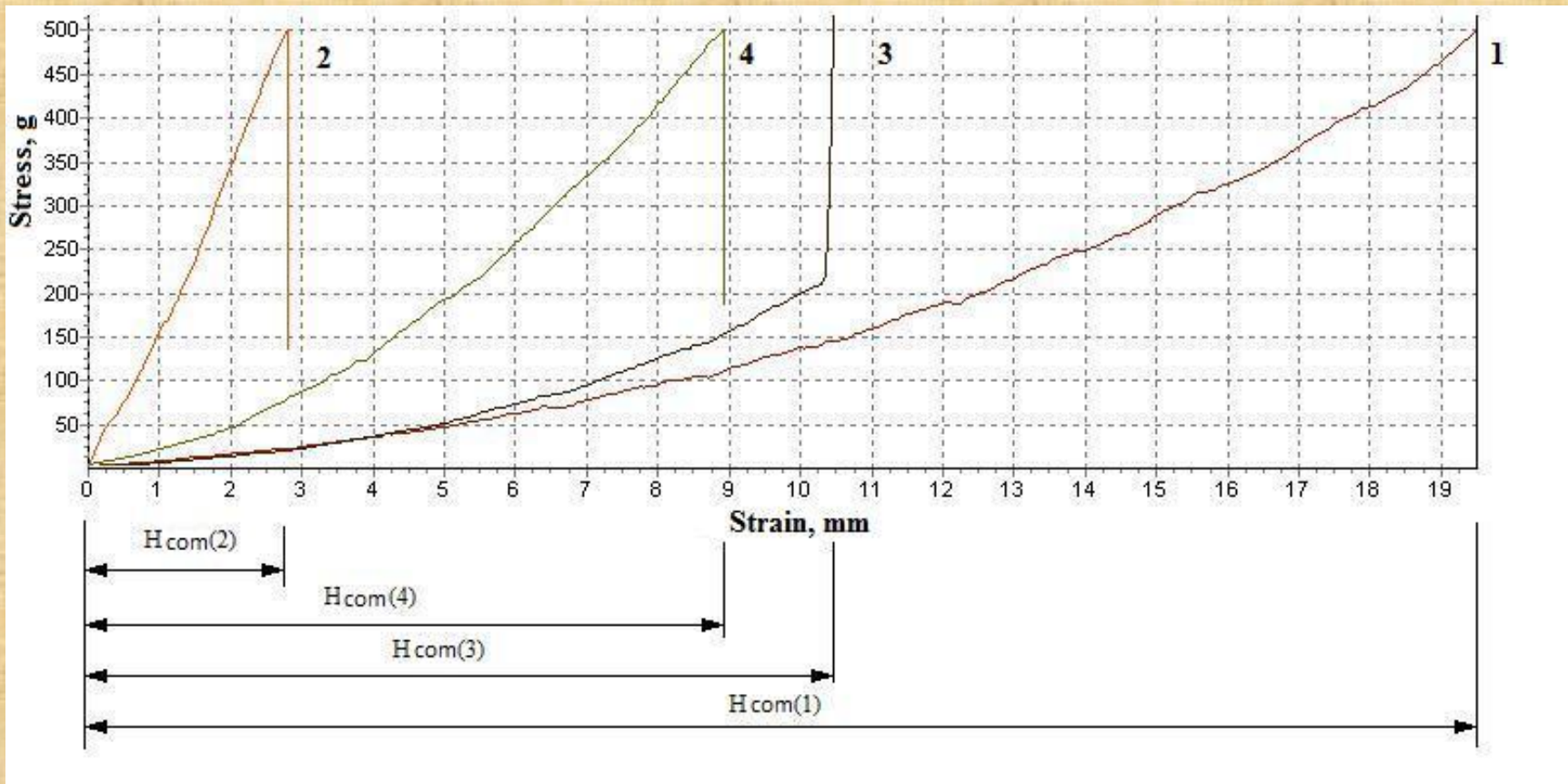
# The main types of dough from oat flour:

- Non-fermented
- Wafer
- Biscuit
- Cookie





**Fig. 3. Structure analyzer “Structurometr-ST-2”**



**Fig. 4. Rheological profile of dough with wheat and oat flour:**

1. Wheat flour + cold water (20°C)
2. Oat flour + cold water (20°C)
3. Wheat flour + hot water (95°C) (boiled flour)
4. Oat flour + hot water (95°C) (boiled flour).



**Fig. 5 Oat profiteroles**

Wholegrain flour – one of the products of the naked oat after hydrothermal pre-treatment, which is the main raw material for manufacturing dough products.

In earlier studies, we have developed recipes and techniques of preparation of gluten-free gingerbread and wafers on the basis of grain from the celiac non-toxic oat cultivars.



**Fig. 6. Sample of gluten-free gingerbreads**

The development of wafers with oat flour and combinations of sweeteners made it possible to recommend them for the use in diabetic diets.



**Fig. 7. Sample of gluten-free wafers with oat flour and combinations of sweeteners**



Table 2. Quality parameters of wafer dough and wafers

Quality parameters of wafer dough and wafer semi-finished products	Samples of wafers				
	Wheat flour			Oat flour	
	Control (sucrose 36%)	Sample №1 (isomaltol 24%, xylitol 6%)	Sample №2 (XOS <sup>(a)</sup> 18%, xylitol 12%)	Control (sucrose 36%)	Sample №3 (isomaltol 15%, xylitol 10%)
Viscosity of dough, Pa·s	0,74	0,74	0,73	1,46	1,78
Relative strain, %	0,28	0,32	0,43	0,19	0,36
Plasticity, %	100,0	136,1	99,6	105,1	121,6
Water absorption, %	413	406	399	501	566
Density, g/cm <sup>3</sup>	0,36	0,38	0,37	0,38	0,40
Hardening temperature, °C	126	120	124	129	128

(a) Xylooligosaccharides

The recipe of a dietary wafer semi-finished product from oat flour that is free from sucrose and wheat gluten, is protected by a patent of the Russian Federation for the invention № 2337550. Commercialization of this invention will broaden the range of health food products available at the domestic market.



# Conclusions

- ❖ Nutritional value and useful properties of oat grains cause the possibility of its application in the development of functional foods and products for special purposes.
- ❖ The increasing demand for food consumption of oat grain requires more in-depth study of food value and technological properties of national oat selection both as commercially cultivated and the newly one.
- ❖ On the structural and mechanical properties of the finished oat products and the rheological properties of the oat dough influence significantly starch and non-starch polysaccharides, but not protein of the grain.
- ❖ Developed profiteroles, prepared without sucrose with whole-grain oat flour, derived from the celiac non-toxic oat varieties, may be recommended in the diet of people with diabetes and celiac disease.

**Thank you**  
**for your attention!**