

## APPLICABILITY OF SERICULTURE IN THE FOOD INDUSTRY AND MEDICINE

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### Abstract

The prevalence of constipation is increasing, one of the causes being the adverse reaction to morphine administration. Besides drug therapy and alternative remedies (yoga, phytotherapy, acupuncture etc.), another method is a change of lifestyle, including diet. The aim of this study is to assess the applicability of sericin in food research and development for special nutritional requirements, including the prevention and treatment of constipation. The study was carried out comparatively with standard food and bovine lactoferrin, in Wistar rats that were administered morphine in order to induce constipation. Of the two glycoproteins analyzed, sericin was the most efficient in improving constipation. Feces with highest deformation, pH, refractometric soluble dry matter were obtained in the group on sericin-supplemented food. No biochemical changes in urine were noted.

**Key words:** sericin, food, chronic digestive diseases

The increase in chronic digestive diseases prevalence is one of the setbacks of this century, modern unhealthy lifestyle, or equality between women and men. Constipation and gastroesophageal reflux are two conditions frequently encountered at all ages, regardless of gender, social status or education. The common causes of the two diseases may be stress, lifestyle (Lee A., 2015; Peppas G. *et al*, 2008), inadequate food (Lee A., 2015; Peppas G. *et al*, 2008), drugs (Peppas G. *et al*, 2008), neurological diseases (Peppas G. *et al*, 2008), and psychosomatic factors (Peppas G. *et al*, 2008).

With the exception of allopathic medicines, both chronic diseases may be improved by alternative measures, such as yoga, press puncture and acupuncture, phytotherapy, change of lifestyle, electro-acupuncture and magnetic resonance.

Food industry is the economic branch of all countries, which, besides the changes and dynamics it constantly undergoes, has also the challenge of researching and developing foods for special nutrition needs. The stake is even higher when considering the following factors involved in the development of new products: the necessity to have human resources specialized in food industry, pharmacology and medicine, to form multidisciplinary teams with other economic agents or academic research in the fields of pharmacology and medicine. And even more, when developing a new product, an important

factor to take into account is the consumer behavior, expiry time, preservation time and, not least, the legislation governing all these factors.

In the last years, sericin resulted by extraction from textile wastes for silk threads has been increasingly studied both in medicine – anti-diabetes, nervous cell repair after ischemic cerebrovascular events (Wang Z. *et al*, 2015), as tissue regenerator and antioxidant (Khampieng T. *et al*, 2015; Gupta D. *et al*, 2014; Takechi T. *et al*, 2014), anticoagulant (Khampieng T. *et al*, 2015), cancer cells inhibition (Khampieng T. *et al*, 2015; Liu J. *et al*, 2016), pharmaceutical substance (Liu J. *et al*, 2016), cosmetics (Khampieng T. *et al*, 2015; Gupta D. *et al*, 2014) and food industry.

European laws regulations – EU 609/2013 and Directives 21/1999, 125/2006, 141/2006 modified and/or appended define aliments for special nutrition needs as those foods destined for “people whose digestive or metabolic processes are disturbed”, and for “individuals who are in a special physiological condition and who therefore may obtain special benefits from the controlled consumption of certain substances from these aliments”.

The main aim of this paper is to determine the efficacy of sericin in improving morphine-induced constipation, with the purpose of reaching and developing a new alimentary product that would prevent / alleviate constipation.

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## MATERIAL AND METHOD

The study was carried out on health female and male Wistar rats. They were divided into 3 groups of 12 animals each (controls, sericin, bovine lactoferrin). The rats were weighed at the beginning of the study and put into marked individual cages. All three groups were left for two days to adapt to the new conditions and standardized for biochemical tests of the urine: pH, density, glucose, bilirubin, proteins, hemoglobin, leukocytes, urobilinogen, ketones, blood, nitrites, physiological state and ethology. The physical and chemical properties of feces were also analyzed. The preclinical study was performed in conditions of controlled microclimate according to species. Over the entire study period the food and water consumption was monitored, each animal having individual food and water dispensers. Two types of metabolic cages were used: standard (**Figure 1**) and specially designed by Eugen Botan (**Figure 2**). The need for the second type was based on the shortcomings of the standard cage: rodent ethology, i.e. urination and defecation in the food storage area, difficult manipulation and hygiene maintenance, high costs. Each rat received 20 g/day fodder, acquired from the "Cantacuzino" National Research Institute, Romania; sericin was bought from Xi'An Zhongyun Biotechnology CO., LTD, China, and bovine lactoferrin brand was *Vivinal Lactoferrin TD* provided by KUK Romania, producer FrieslandCampina DMV B.V, Netherlands.



Figure 1 Standard metabolic cage



Metal cage  
Wire mesh (separation of fecese)  
Plastic support (urine collection)

Figure 2 Metabolic cage - Eugen Boțan

Before administration of morphine and the two glycoproteins, all the rats were kept in fasting in order to empty their GI tract, with water given freely. Morphine was administered intramuscularly, while food was given moist in water – sericin and water – bovine lactoferrin solutions respectively; amount was reduced by 25% of the normal average daily ration in order to ensure the complete consumption of the glycoproteins tested. All cages were cleaned daily, and physical and biochemical tests were performed on fresh samples.

The lactoferrin and sericin doses were calculated considering the maximal lactoferrin content in food products for special needs, a maximum of 3 g/day (Decision 2012/7272/EU of the Commission authorizing the marketing of bovine lactoferrin as a new food ingredient, based on the CE Regulation 258/97 of the European Parliament and Council (FrieslandCampina) – for human consumption. The amount of sericin and lactoferrin respectively was 13 mg/animal/day.

The results of biochemical tests in urine over the whole study period is presented in Table 1

## RESULTS AND DISCUSSION

Tabel 1

Results of the biochemical tests of urine over the study period

Parameter	Normal values of rat urine	Control group (12 animals)	Sericin group (12 animals)	Bovine lactoferrin group (12 animals)
Urobilinogen	ND	0,1	0,1	0,1
Glucose	Negative, or traces	Negative	Negative	Negative
Bilirubine	Negative	Negative	Negative	Negative
Ketonic bodies	Negative	Negative	Negative	Negative
Density	1.022 – 1.05	1.03	1.03	1.03
Blood	Negative	Negative	Negative	Negative
pH	5...7	5	5	5
Proteins	< 30	Negative	Negative	Negative
Nitrites	ND	Negative	Negative	Negative
Leukocytes	ND	Negative	Negative	Negative

ND – not determined

Over the study period (7 days) no ethologic and biochemical changes in urine were found. The results of the physical and chemical tests of feces are presented in figures 3 – Mean Brix values (refractometric soluble dry solid substance), 4 – mean pH values, and 5 – Mean values of plastic deformation.

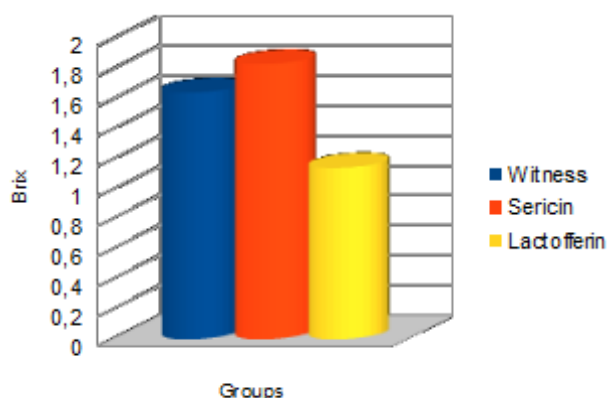


Figure 3 Mean Brix values in feces

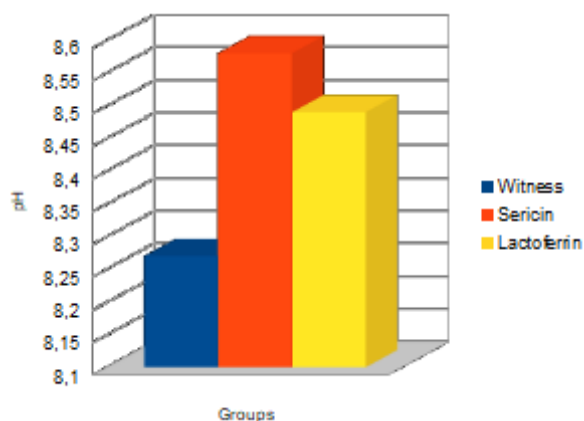


Figure 4 Mean pH values of feces

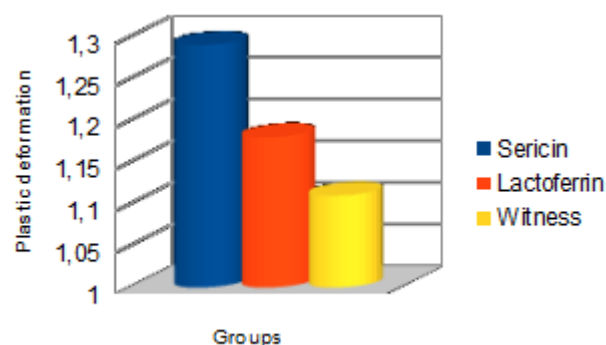


Figure 5 Mean plastic deformation values of feces

The results evidence that the feces of the rats in the sericin group had the highest Brix, glucose contents and plastic deformation, meaning that these feces had the highest water content. The mean pH value of the sericin group shows that sericin did not alter the feces pH, the baseline value being preserved during the study period.

The study carried out on Wistar rats fed with sericin and bovine lactoferrin 13 mg/animal/day provide the first findings regarding: the feces plasticity by refractometric method, rat urine biochemical parameters, use of sericin 3 g/day for human consumption, improvement of opiates-induced constipation, the need for a new type of metabolic cages in such experimental studies, and maintenance of feces alkalinity.

According to Japanese authors (Yukako O. *et al.*, 2011), sericin consumption increases the amount of IgA and butirate in the colon and the mucosa, it minimizes the risk of colon cancer and ulcerative colitis, decreases triglycerides levels in the liver and serum, improves glucose tolerance, sericin having also a probiotic potential.

## CONCLUSIONS

Of the two glycoproteins assessed, sericin was the most effective in improving morphine-induced constipation. Following the biochemical tests of urine, no alterations of the renal and hepatic systems were found with the administration of 13 mg sericin/animal/day. In order to obtain the Scientific Approval of the EFSA (European Food Safety Authority), we shall perform another experimental study that will verify the biochemical results of urine from a pathomorphological viewpoint and will establish DL50, the therapeutic ratio and safety dose.

Sericin represents a potentially new ingredient of food products destined for special nutrition needs – constipation - and a new substance to be used in the pharmaceutical industry.

The development of sericulture in Romania and the extraction of sericin may lead to a

competitive price, both for researchers and the food and pharmaceutical industries.

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