

COMPOSITION AND PHYSICO-CHEMICAL PROPERTIES OF LYOPHILIZED ROYAL JELLY

Liyofilize Arı Sütü Bileşimi ve Fiziko-Kimyasal Özellikleri

(Genişletilmiş Türkçe Özet Makalenin Sonunda Verilmiştir)

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Key words: lyophilized royal jelly, freeze-drying, composition, physico-chemical properties

Anahtar kelimeler: liyofilize arı sütü, dondurma-kurutma, bileşim, fiziko-kimyasal özellikler

ABSTRACT

The aim of the research was to study some of the components and physico-chemical properties of lyophilized royal jelly (LRJ). Six royal jelly samples produced in Bulgaria were lyophilized. The samples were preserved at -18 °C before analysis. Water content, proteins, lipids, sugars, ash, pH, total acidity and electrical conductivity were analyzed. It was found that LRJ contains: water (3,49–4,76%), lipids (3,09–8,56 %), fructose, glucose and sucrose (24,27–32,67 %), ash (2,50–3,03 %), pH (3,8–4,0), total acidity (10,67–12,88 ml 0,1 N NaOH/g). The values of LRJ electrical conductivity of 1 % water solution was in the range 421–481 µS/cm.

INTRODUCTION

Royal jelly is a bee product secreted from the hypopharyngeal and mandibular glands of young worker honeybees (*Apis mellifera*) and involved in their sexual determination (Goewie, 1978). It is used to feed young larvae and has a fundamental role in caste differentiation.

Royal jelly is one of the most interesting natural products. It contains such biologically active substances as 10-hydroxy-2-decenoic acid. Royal jelly also has various pharmacological effects including antibiotic (Melliou and Chinou, 2005), antibacterial (Abd-Alla et al., 1995; Fujiwara et al., 1990) and antiproliferative effects (Nakaya et al., 2007).

Various compounds such as proteins, sugars, lipids, vitamins, minerals, and free amino acids have been identified. Royal jelly is a substance with a complex chemical structure. Fresh royal jelly consists of

water (60 – 70 %), proteins (9 – 18 %), sugars (7–18 %), lipids (3–8 %), essential amino acids, vitamins, and minerals. Lyophilized Royal Jelly (LRJ) contains less than 5 % of water, 27–41 % of proteins, 22–31 % of carbohydrates and 15–30 % of lipids (Sabatini et al., 2009; Nagai and Inoue, 2004).

Royal jelly is widely used in human diets and alternative medicine. Though in Bulgaria there are insufficient studies in this area. The purpose of the current research is to determine the main components and physico-chemical properties of LRJ samples from Bulgaria.

MATERIALS AND METHODS

Six royal jelly samples produced in Bulgaria (South-Western and North-Eastern Bulgaria) were investigated. The lyophilized royal jelly was made from fresh royal jelly by removing most of the water by freeze-drying. It was lyophilized in the Institute of

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Cryobiology and Food Technology, Sofia, Bulgaria. The samples were stored at -18 °C before analysis.

The following parameters were determined: Proteins – after Folin-Ciocalteu; lipids by Soxhlet procedure using diethyl ether as solvent; sugars (fructose, glucose, sucrose) by HPLC after Sesta 2006; water content by direct drying with infraredmoisture analyzer; ash content by

gravimetry using oven at 550 °C; pH by pH meter model Mi 150 and total acidity by titration with 0,1 N NaOH; electrical conductivity of 1 % water solution of LRJ by conductimeter. Statistical analysis was performed using MS Excel 2007.

RESULTS AND DISCUSSION

The chemical composition of LRJ samples are presented in Table 1.

Table 1. Water content, dry matter, proteins, lipids, ash, fructose, glucose, sucrose, total sugars, pH, total acidity and electrical conductivity of LRJ

Contents	N	Means±S. E.	Min.	Max
Water Content, %	6	3,99±0,18	3,49	4,76
Drymatter, %	6	96,02±0,18	95,24	96,51
Proteins, %	6	38,11±1,23	34,09	41,80
Lipids, %	6	6,22±0,72	3,09	8,56
Ash, %	6	2,75±0,08	2,50	3,03
Fructose, %	6	11,85±0,45	10,37	13,64
Glucose, %	6	9,9±0,94	6,82	12,78
Sucrose, %	6	7,65±1,11	4,19	11,62
Total Sugars, %	6	29,4±1,16	24,27	32,67
pH	6	3,87±0,03	3,80	4,00
Total acidity, ml 0,1 N NaOH/g	6	11,66±0,3	10,67	12,88
Electrical conductivity, µS/cm	6	451,33±9,03	421,00	481,00

The water content of our LRJ samples was between 3,49 – 4,76 %. This is in accord with previous scientific researches reporting a range of 2,66 to 5,70% (Karaali et al.,1988;Messia et al., 2005).

The proportion of the proteins in LRJ is large. The average value of LRJ total protein in our study was 38,11 % (34,09 – 41,80 %). Similar results were reported by Ivanov and Mitev (1980) and Simúth (2001).

The content of LRJ total lipids was between 3,09 – 8,56 %. Ivanov and Mitev (1980) and Sabatini et al., (2009) reported higher total lipids values in comparison to our values. This fact could be explained with the high variation of this index in the tested product. The average ash content in the present study was 2,75 % (2,50 – 3,03 %). Ivanov and Mitev, 1980; Simúth, 2001 and Sabatini et al., 2009 reported similar values. The ash content and the concentration of mineral elements do not exhibit a large range.

The concentrations of the most abundant sugars fructose, glucose and sucrose ranged from 10,37 – 13,64 %, 6,82 – 12,78 %, and 4,19 – 11,62 %, respectively (see Table 1). These values are comparable with the sugar levels reported in the literature (Simúth, 2001; Sabatini et al., 2009). There is some variation in values for individual samples which is normal for organic products. According to Simúth (2001), the content of glucose (18,8 %) is higher than that of fructose (14,0 %). In our study minimum and maximum fructose values were also higher in those of glucose. Sabatini et al., (2009) reported that fructose is prevalent to glucose which was also confirmed in our study. Sucrose is always present but in highly variable concentrations. Thus the amount of analyzed royal jelly samples is insufficient to draw conclusions about the prevalence of glucose or fructose.

Royal jelly is highly acidic (pH 3,4-4,5) with a density of 1,1 g/ml (Lercker, 2003). According to Scarselli (2005) royal jelly is a white-yellow colloid with a pH between 3,6–4,2. It is opaque and relatively acidic (pH 3,9-4,1) (Sauerwald, 1997). As

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can be seen in Table 1, pH and total acidity vary between 3,8–4,0 and 10,67–12,88 ml 0,1 N NaOH/g, respectively.

Electrical conductivity in royal jelly is determined by the content of mineral elements, organic acids, amino acids and proteins in it. Electrical conductivity of 1 % water solution of LRJ varies between 421 – 481 μ S/cm.

CONCLUSION

The present results suggest that the content of the main components and physico-chemical properties of LRJ does not vary to a large extent. The average values of the general chemical composition of royal jelly collected in this study are comparable with those of royal jelly samples produced in other countries.

This chemical analysis of LRJ produced in Bulgaria demonstrated that it is composed of protein content (38,11 % \pm 1,23), sugar content (fructose, glucose, sucrose – 11,85% \pm 0,45, 9,90 % \pm 0,94, 7,65 % \pm 1,11, respectively), lipid content (6,22 % \pm 0,72), ash content (2,75 % \pm 0,08), and water content (3,99 % \pm 0,18). The pH, total acidity and electrical conductivity values are 3,87 \pm 0,08, 11,65 ml 0,1 N NaOH/g \pm 0,3, 451,33 μ S/cm, \pm 9.03, respectively.

Based on the above data a standard for Bulgarian LRJ could be proposed.

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GENİLETİLMİŞ ÖZET:

Giriş: Arı sütü genç işçibalarılarının hipofarangi? - işçibalarılarının hipofarangi? - alveolar bezlerinden salgılanan ve şeybelirlemesinde yer alan bir ürünüdür. Genç larvaları beslenmesinde?

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kullanılmaktavesını fayrılması datemel görevibulunmaktadır. Arı sütü ilginç doğal bir ürün olup biyolojik olarak aktif 10-hidroksi-2-dekenoikasitiçermekteveantibiyotik, antibakteriyalveantiprolifer?-atiffarmakolojik etkileribulunmaktadır.Şu ana kadar içeriğinde proteinler, şekerler, yağlar, vitaminler, mineraller ve serbest amino asitler olmak üzere çok sayıda bileşik belirlenmiştir. Arı sütü insan diyetinde ve alternatif tıpta da kullanılmasına rağmen Bulgaristan'da bu alanda yeterli çalışma yoktur. Bu çalışmada Bulgaristan'dan elde edilen liyofilize arı sütünün temel içeriği ve fiziko-kimyasal özellikleri belirlenecektir.

Materyal ve Metod: Bu çalışmada Bulgaristan'da üretilen 6 arı sütü örneği incelenmiştir. Liyofilize arı sütü, taze arı sütlerinden suyu dondurma-kurutma metodu uygulayarak uzaklaştırma sonucu yapılmıştır. Daha sonra örnekler -18°C 'de saklanmıştır. Proteinler, Folin-Ciocalteu metoduna, yağlar dietil eterin çözücü olarak kullanıldığı Soxhlet metoduna,

şekerler, HPLC ile Sesta metoduna, su, infrared nem analizatörü ile, kül gravimetric metoduna göre, %1 su solüyonunun elektriksel geçirgenliği kullanılarak konduktimetre ile ölçülmüş ve istatistiksel analizler MS Excel 2007 ile yapılmıştır.

Sonuç ve Tartışma: Bu çalışmada ölçülen liyofilize arı sütü değerleri (temel içerik ve fiziko-kimyasal değerler) literatürdeki değerlerden farklı değildir. Yapılan karşılaştırmalarda diğer ülkelerde elde edilen değerler Bulgaristan'da üretilen arı sütü değerleri ile uyumludur. Bulgaristan arı sütü için elde edilen değerler protein miktarı 38.11 ± 1.23 , fruktoz miktarı 11.85 ± 0.45 , glukoz miktarı 9.90 ± 0.94 , sukroz miktarı 7.65 ± 1.11 , yağ miktarı 6.22 ± 0.72 , kül miktarı 2.75 ± 0.08 , su miktarı 3.99 ± 0.18 , pH 3.87 ± 0.08 toplam asitlik 11.65 ± 0.3 ml 0.1 N NaOH/g ve elektriksel konduktivite $451,33 \pm 9.03$ $\mu\text{S}/\text{cm}$ olarak bulunmuştur. Bu değerlere dayanarak Bulgaristan liyofilize arı sütü standart değerleri önerilmiştir.