Macedonian Pharmaceutical Bulletin, 72 (Suppl 1) 619 - 620 (2026)
Online ISSN: 1857-8969
DOI: 10.33320/maced.pharm.bull.2026.72.03.299
Short communication

Microscopic authentication of commercial salep products: a simple approach for adulteration detection

Anastasija Gadzoska[1*], Filip Todorov[1], Kosta Najkov[2], Petre Makreski[2], Ivana Cvetkovikj Karanfilova, Ana Trajkovska Matevska, Iskra Davkova[1], Marija Karapandzova[1], Gjoshe Stefkov[1], Veronika Stoilkovska Gjorgievska[1]

[1]*Institute of Pharmacognosy, Faculty of Pharmacy, Ss. Cyril and Methodius University in Skopje, Majka Tereza 47, 1000 Skopje, Republic of North Macedonia*
[2]*Institute of Chemistry, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University in Skopje, Arhimedova 5, 1000 Skopje, Republic of North Macedonia*

Introduction

Salep is a traditional food product obtained from the powdered dry tubers of different wild orchid species (*Orchis* spp.) and is widely consumed as a hot beverage. Its characteristic texture and nutritional properties are mainly attributed to mucilaginous polysaccharides, particularly glucomannan (Masters et al., 2022). Due to the limited availability of wild orchid tubers and the high market value of salep, commercial products are frequently adulterated with starch, leading to reduced quality and potential consumer deception.

The quality control of salep remains challenging, as many analytical methods used for adulteration detection are costly, labor-intensive, and unsuitable for routine quality control. Microscopic analysis offers a simple, rapid, and cost-effective alternative, enabling the identification of characteristic anatomical elements of salep and potential adulterants. Therefore, the aim of this study was to develop and evaluate a microscopic approach for the detection of adulteration in commercial salep samples and to establish practical microscopic test for routine quality control.

Materials and methods

Plant material

Authentic salep powder obtained from orchid tubers was used as a reference material, while maize starch and milk powder were included as potential adulterants. Five commercial salep products (CSP 1–5) were purchased from local markets and analyzed for authenticity.

Microscopic method

Microscopic examination was performed using a light microscope equipped with a Nikon 3500 digital camera connected through an imaging adapter. Samples were dispersed in chloral hydrate solution and examined under different magnifications (4×, 10× and 40×). For semi-quantitative evaluation, five representative photos were acquired at 10× magnification for each sample. Characteristic microscopic elements were identified based on the reference materials and included starch granules (maize starch), spherical particulate structures (milk powder), parenchymatous tissue fragments, vascular elements and mucilaginous aggregates (authentic salep). These elements were manually counted in each image, and the mean number of elements per

*anastasijagadzoska04@gmail.com

field was calculated from the five analyzed photo for each sample. The abundance of the characteristic elements was used as a criterion for authenticity assessment and detection of potential adulteration.

Results and discussion

Microscopic examination of authentic salep revealed a high abundance of parenchymatous tissue fragments (approximately 120–180 elements per field), vascular remnants (20–35 elements per field) and mucilaginous aggregates (15–25 elements per field), corresponding to a high to very high abundance of characteristic salep structures. In contrast, maize starch was characterized by a very high abundance of starch granules (approximately 900–1150 granules per field) and the absence of diagnostic salep elements, whereas milk powder contained predominantly spherical particles (approximately 30–120 particles per field) without recognizable plant tissue structures.

Among the commercial salep products (CSP), marked differences in microscopic composition were observed. CSP-1 exhibited approximately 35–42 tissue fragments and 50–70 starch granules per field, indicating a mixed formulation containing both plant-derived material and starch-rich components. CSP-2 showed the highest similarity to authentic salep, containing approximately 45–60 tissue fragments and only 25–42 starch granules per field, together with abundant mucilaginous material. CSP-3 was dominated by starch granules (>1000 granules per field), while only 10–30 salep-like tissue fragments were observed. CSP-4 displayed the highest abundance of starch granules (approximately 800–1500 granules per field) and only 2–10 tissue fragments per field, suggesting a predominantly starch-based formulation. CSP-5 showed an intermediate profile, containing approximately 40–80 tissue fragments, 15–30 mucilaginous aggregates and 300–700 starch granules per field.

Based on the abundance of diagnostic microscopic elements, the analyzed samples could be ranked according to their similarity to authentic salep as follows: authentic salep > CSP-2 > CSP-5 > CSP-1 > CSP-3 > CSP-4. The results demonstrate that the relative abundance of parenchymatous tissue fragments, mucilaginous aggregates and starch granules provides a practical criterion for distinguishing authentic salep from adulterated or highly diluted commercial products.

De Boer et al. (2017), using DNA metabarcoding, demonstrated widespread substitution of commercial salep products with non-orchid thickening agents, including guar gum and cereal-derived materials such as wheat, rye, barley and maize. Consistent with these findings, the present microscopic analysis revealed marked differences in the abundance of starch granules and characteristic salep tissue fragments among commercial products, indicating varying degrees of dilution or substitution with starch-rich materials.

Conclusion

Light microscopy enabled rapid differentiation between authentic salep, common adulterants and commercial salep beverages based on the abundance of parenchymatous tissue fragments, mucilaginous aggregates and starch granules. While authentic salep exhibited characteristic orchid tuber anatomical elements, substantial differences were observed among commercial products, with some samples showing profiles similar to authentic salep and others being dominated by starch-rich components. The proposed microscopic approach represents a simple and cost-effective method for preliminary authentication and detection of salep adulteration.

References

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