SILVER NANOPARTICLES FOR MEDICAL APPLICATIONS PRODUCED WITH THE USE OF STABILIZING-REDUCING COMPOUNDS DERIVED FROM NATURAL RESOURCES

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Introduction

Silver nanoparticles (SNPs), are among the most attractive nanomaterials, and thanks to their antibacterial properties they have been widely used in a range of biomedical applications, e.g. in medical device coating, dental instruments, bandages and for personal health care [1,2]. They have also found applications in the diagnosis and treatment of cancer and as drug carriers in eye care for coating contact lenses [3]. In addition, the use of SNPs in combination with vanadium oxide in battery cell components was found to improve battery performance in the next-generation active implantable medical devices. SNPs can be used in bio-diagnosis, where their plasmonic properties strongly depend on size, shape and dielectric properties of the surrounding medium [4]. A wide range of physical and chemical techniques have been developed to produce SNPs of different size, shape and compositions [3,5]. Nowadays pioneering, more environment-friendly techniques that are using biological substrates are of particular importance [6].

The aim of this study was to obtain SNPs suspension with desirable physicochemical characteristics with the use of extracts of different kinds of coffees acting as stabilizing-reducing agents.

Materials and Methods

Samples of coffees from around the world were tested as reducing and stabilizing agents in chemical reduction method of SNPs preparation processes. Nanosuspension was obtained by adding 0.07875 g of $AgNO_3$ salt to 100 ml of water and dropwise 7 ml of the cooled coffee extract. Silver nanosuspension of 500 ppm was obtained using water as a solvent. Nanoparticle formation was observed using UV-vis spectroscopy in the range of 300-700 nm (Evolution 220 UV-Visible spectrophotometer).

After preparation, analysis of the influence of selected parameters on the physicochemical properties of obtained metallic nanosuspensions were conducted. Afterwards, stability analysis of obtained metallic nanosuspensions depending on the time, temperature and amount of infusion were tested. Material analysis was performed by HPLC and the antioxidant capacity of coffee samples was determined using Folina-Ciocalteu (F-C) and DPPH reagents.

Results and Discussion

The results of caffeine content measured by HPLC, antioxidant capacity by DPPH reagent and F-C reagent are shown in TABLE 1. Instant coffee and green coffee contain the highest amount of caffeine. This may be the result of the coffee preparation process. Contrarily to other coffee samples green coffee is not roasted. The highest antioxidant properties has instant coffee followed by Tchibo and Green coffee. Tchibo coffee was found the most efficient in SNPs preparation. In the time-dependent graph (FIG. 1), it can be seen that nanoparticles' synthesis proceeds the most effectively after 90 and 120 min. It can be observed that nanoparticles are relatively stable over time.

TABLE 1. Content of caffeine and antioxidant capacity evaluated by DPPH F-C reagents, respectively in different coffees used as reducing and stabilizing agents in SNPs synthesis.

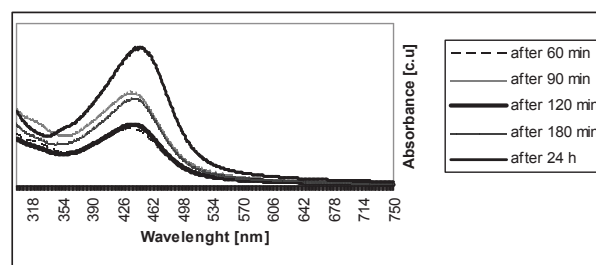| Coffee	Caffeine content [mg/l]	% inhibition	Gallic acid [mg/ml]
Puro de altura coffee	2.89±0.03	8.60±0.01	0.29±0.02
Green coffee	5.37±0.01	11.65±0.09	0.32±0.02
Tchibo coffee	1.95±0.13	12.29±0.09	0.29±0.05
Instant coffee	7.18±0.05	40.75±0.06	0.46±0.05
Coffee from Nicaragua	3.52±0.12	2.81±0.07	0.21±0.02
Coffee from Mexico	2.95±0.02	5.06±0.03	0.18±0.03
Lavazza coffee	3.51± 0.02	8.33±0.03	0.24±0.04

FIG. 1. UV-vis spectra of silver suspension from Tchibo coffee-water at room temperature depending on synthesis time.

Conclusions

Based on the study it can be concluded that different types of coffee have different caffeine content and antioxidant properties. The highest caffeine content and antioxidant properties has instant coffee, while the lowest caffeine content has Tchibo coffee. Extract from Tchibo coffee was found the most effective stabilizing-reducing agent in preparation of stable SNPs suspensions. There is not a clear relationship between the formation of SNPs and the antioxidant capacity of coffee.

Acknowledgments

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