Sudan University of Science and Technology

Faculty of Engineering and Technology

M.sc of Biomedical Engineering

Design of detector for vaccines container based on gold nanoparticles

تصميم كاشف لحاويات الأمصال باستخدام جسيمات الذهب النانوية

Thesis Submitted for fulfillment of the Requirement for M.Sc. Degree in Biomedical Engineering

By

Hala Awad Alkareem Ali Mohammed

Supervisor:

Dr. Fragoon Mohammed Ahmed

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بسم الله الرحمن الرحيم

يَا بُنَيَّ إِنَّهَا إِن تَكُ مِثْقَالَ حَبَّةٍ مِّنْ خَرْدَلٍ فَتَكُن فِي صَخْرَةٍ أَوْ فِي السَّمَاوَاتِ أَوْ فِي الْأَرْضِ يَأْتِ بِهَا اللَّهُ ۚ إِنَّ اللَّهَ لَطِيفٌ خَبِيرٌ

سورة لقمان ,الآية 16

DEDICATION

I lovely dedicate this thesis to my…

Dearly loved parents

Precious brothers & sisters

Great teachers

,,,,,

For all my lovers

&

For all those searching for knowledge

,,,,,,,,,,

,,,,,

HALA

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*First of all, praise is due to Almighty **ALLAH** with His compassion and mercifulness to allow me finalizing this M.SC Project.*

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Abbreviations

GNPS	gold nanoparticles
NPs	nanoparticles
Au	gold
HAuCl4	Hydrogen tetrachloroaurate tetrahydrate
LSPR	Plasmon Resonance
UV-Vis	Ultraviolet-visible spectroscopy
FTIR	Fourier transforms infrared
XRD	X-ray diffraction
SEM	Scanning electron microscopy
TEM	Transmission electron microscopy
AFM	Atomic force microscopy
TA	Thermal Analysis
EDX	Energy-Dispersive X-ray
Cu	copper

ABSTRACT

Vaccines container detector based on gold nanoparticles was synthesized according to plant seeds extract method which is simple, efficient, economic and environmentally

In this study two types of seeds were used to produce gold nanoparticles: black seed (Nigella sativa) and fenugreek seed (Trigonella foenum graecum) extracts as reducing agent to reduction of gold precursor of Au^{+3}(HAuCl) to Au^{0} in the presence of a stabilizer (Gum Arabic) which keeps nanoparticles apart, thus avoiding their aggregation.

The produced gold nanoparticles were characterized by using and ultraviolet-visible absorption spectroscopy, X-ray diffraction and transmission electron microscopy. It was found that the concentration of the precursors affects the size of the nanoparticles. Typical images obtained for black seed colloids consist of almost uniformly sized spherical nanoparticles, while fenugreek consist of different shapes of gold nanoparticles.

The generated gold nanoparticles were used as detector from which can change its color irreversibly when the solution become frozen ($0\ ^{0}C \pm 0.5$) by adding chemical material (glucose and silica gel) to give faster respond to temperature change.

For the detector find that the more increase of the amount of glucose added to the gold nanoparticles solution whenever given the change in the color characteristics and faster. As well as the selection of glucose gives a change in the characteristics and best results when compared to choose silica gel.

A find that the fenugreek in response to the change in temperature faster than black seed as well as change color characteristics in a short time, which gives a good indication to an application in vaccines to check the degree of preservation and freezing.

المستخلص

كاشف وحدات حفظ الأمصال باستخدام جسيمات الذهب النانوية تم تصنيعه باستخدام تقنية استخلاص بذور النباتات وهي طريقة بسيطة ,فعالة ,اقتصادية وصديقة للبيئة.

في هذه الدراسة تم استخدام نوعين من مستخلص البذور لانتاج جسيمات الذهب النانوية : الحبة السوداء (حبة البركة) وبذورالحلبة كعامل مختزل لاختزال جسيم الذهب في وجود الصمغ العربي الذي يحافظ على الجسيمات النانوية بعيدا عت بعضها لتجنب ارتباطها.

جسيمات الذهب النانوية الناتجة تم تحليلها باستخدام جهاز الأشعة فوق البنفسجية , المجهر الالكتروني و حيود الأشعة السينية . وجد ان تركيز المحلول يؤثر على حجم الجسيمات النانوية . الصور النموذجية لجهاز المجهر الالكتروني لبذور الحبة السوداء معظمها كروية الشكل , في حين ان الحلبة تحتوي على عدد من الأشكال المختلفة

وأستخدمت الناتج لتصنيع المتحقق والذي يمكن تغيير لونه بشكل لا رجعة فيه عند اضافة المواد الكيميائية (الجلوكوز وهلام السيليكا) لإعطاء أسرع استجابة لتغير درجات الحرارة

للمتحقق تجد أن زيادة كمية الجلوكوز المضافة لمحلول جسيمات الذهب النانوية تعطي زيادة في سرعة تغير الالوان وتغير الخصائص. وكذلك اختيار الجلوكوزيعطي تغيير في الخواص ونتائج افضل عند المقارنة في اختار هلام السيليكا.

نجد أن الحلبة استجابتها لتغير درجة الحرارة أسرع من الحبة السوداء، وكذلك خصائص تغير لونها في وقت قصير، مما يعطي مؤشرا جيدا لتطبيقها في الامصال للتحقق من درجة حرارة حفظها