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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

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

يَا بُنَيَّ إِنَّهَا إِنْ تَكُ مِثْقَالَ حَبَّةٍ مِنْ حَرْدَلٍ فَتَكُنْ فِي صَخْرَةٍ أَوْ فِي السَّمَاوَاتِ
أَوْ فِي الْأَرْضِ يَأْتِ بِهَا اللَّهُ إِنَّ اللَّهَ لَطِيفٌ خَبِيرٌ

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DEDICATION

I Sincerely dedicate this thesis to my...

*D*early loved parents

*P*recious brothers & sisters

*G*reat teachers

.....

*F*or all my lovers

&

*F*or all those searching for knowledge

.....

.....

*H**A**L**A*

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Abbreviations

GNPS	gold nanoparticles
NPs	nanoparticles
Au	gold
HAuCl ₄	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 $\text{Au}^{+3}(\text{HAuCl}_4)$ 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 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 ($0^{\circ}\text{C} \pm 0.5$) 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.

المُسْتَخْلَصُ

كما يوضح الصورة أدناه، فإن حفظ الأوصاف باستخدام جسيمات الذهب النانوية تم تضليله 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) وبذور الحلبة كعامل مخترال جسيم الذهب في وجود الصمغ العربي الذي يحافظ على الجسيمات النانوية. بعدد اعut بعضها لتجنب ارتباطها.

جسيمات الذهب النانوية الناتجة تم تحليلها باستخدام جهاز الأشعة فوق البنفسجية ، المجهر الإلكتروني و حيد الأشعة السينية . وجد ان تركيز المحلول يؤثر على حجم الجسيمات النانوية . الصور النموذجية لجهاز المجهر الإلكتروني لبعض 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 لغير درجات الحرارة

للمتحقق تجد أن زيادة كمية الجلوكوز المضافة لمحلول جسيمات الذهب النانوية تعطي زيادة في سرعة تغير الألوان وتغير الخصائص. وكذلك اختيار الجلوكوز يعطي تغيير في الخواص ونتائج أفضل عند المقارنة في اختيار هلام

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