

Sudan University of Science and Technology

**PHENOLIC CONTENTS AND ANTIOXIDANT
ACTIVITY OF SUDANESE HONEY**

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المحتوي الفينولي و نشاط مضادات الأكسدة
في عسل النحل السوداني**

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بسم الله الرحمن الرحيم

:قال تعالى في محكم تنزيله

**وأوحى ربك إلى النحل أن اتخذي من الجبال بيوتاً ومن
الشجر ومما يعرشون* ثم كلي من كل الثمرات فاسلكي
سبل ربك ذللاً يخرج من بطونها شرابٌ مختلفٌ ألوانه
"فيه شفاء للناس إن في ذلك لآية لقوم يتفكرون"**

صدق الله العظيم

(النحل- الآية (67-68)

DEDICATION

**With my love,
I dedicate this thesis to
The Soul of my Father,
My Mothers,
My Dear Husband
and to My Family**

Sumaya

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LIST OF ABBREVIATIONS

a*, b* : Chromatic components (red, yellow)

L* : Lightness component

P : Probability level

r : Correlation coefficient

IW₅₀ : Dry weight (µg)causing 50% of inhibition

TSS : Total soluble solids

ROS : Reactive oxygen species

RNS : Relative nitrogen species

PG : Propyl gallate

TBHQ: Tert-butyl hydroquinone

BHA : Butylated hydroxyanisole

BHT : Butylated hydroxytoluene

TBA : Thiobarbituric acid

TBARS: Thiobarbituric acid reactive substances

HPLC : High performance Liquid Chromatography

ABSTRACT

This investigation was carried out to determine the phenolic contents and antioxidant activity of Sudanese honey. Seven samples of Sudanese honey were tested for phenolic content, antioxidant activity and other parameters such as moisture, pH, refractive index, ash, total soluble solids, protein, electrical conductivity and colour intensity.

Results of analysis demonstrated that there is a good amount of phenolic content and antioxidant activity in Sudanese honey. It ranged from 4.4 to 201.1 mg/TAE/100 g honey for phenolic content. The highest amount of total phenolic content was found in the *Acacia nilotica* honey (Sunut) 201.1 mg/TAE/100 g honey followed by the *Balanites aegyptiaca* honey (Heglig) 146.38 mg/TAE/100 g honey and then came *Acacia seyal* honey (Talih) 67.11 mg/TAE/100 g honey. Honey from Two types of *Ziziphus spina-christi* (Sidir of mountain and Sidir) showed similar values 21.98 and 20.15 mg/TAE/100 g honey respectively , while honey of *Azadirachta indica* (Neem) was found to contain 17.15 mg/TAE/100 g honey and honey from *Cucurbita maxima* Duch. (Pumpkin) was found to contain 4.44 mg/TAE/100 g honey.

For antioxidant activity, it ranged from 3177 to 6247µg for dry weight sample cause 50% inhibition, which indicates antioxidant activity. The maximum antioxidant effect was found in *Azadirachta indica* honey (Neem) 3177 µg followed by *Balanites aegyptiaca* honey (Heglig) 4045 µg, then *Ziziphus spina-christi* honey (Sidir) 4068 µg, and *Acacia seyal* honey (Talih) 4679 µg, while *Ziziphus spina-christi* honey (Sidir of mountain) was 5125 µg. The minimum antioxidant effect was observed in

Acacia nilotica honey (Sunut) 6247 µg, followed by *Cucuribia maxima* Duch. honey (Pumpkin) 5323 µg.

Results of this study showed highly significant differences ($P<0.01$) in phenolic contents of different honey samples. There was no correlation ($r =0.441$) between antioxidant activity and total phenolic content .

Percent of inhibition increased with increasing the concentration. There was highly positive Correlation between concentrations (5, 25 and 50µl) of diluted honey samples and the percent of inhibition, which indicates the antioxidant activity.

Results of parameters such as protein, °Brix and electrical conductivity are within the standard levels and they ranged from 0.200-0.286, 75.2-79.0 and 0.20-0.80 for protein, °Brix and electrical conductivity, respectively. Highly significant differences ($P<0.01$) were observed for other parameters such as moisture, pH, refractive index and ash, with Values ranging from 16.20-21.27%, 3.70-4.80%, 1.4833-1.4960% and 0.1207-1.205% , respectively. The Brix in honey showed significantly high negative correlation ($P<0.05$) ($r=-0.869$) with moisture content.

Colour of honey samples was measured by using Aminolta chromameter and the values of L^* , a^* and b^* were obtained and the values of chroma, hue angle, and browning index were calculated . The ranges of 24.47-59.44, -1.26-8.41 and 2.40-22.02 for L^* , a^* and b^* , respectively, while the calculated ranges of 2.70-22.30, 62.68-89.51 and 11.76-82.35 were obtained for chroma, hue angle and browning index, respectively.

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
ملخص الأطروحة

أجرى هذا البحث لتحديد محتوى المواد الفينولية ومضادات الأكسدة فى العسل السودانى. تم إختبار سبع عينات من العسل السودانى لتحديد محتواها من المواد الفينولية ونشاط مضادات الأكسدة؛ وأيضاً تم تحديد محتواها الرطوبى والأس الهيدروجينى ومعامل الإنكسار والرماد والمواد الصلبة الذائبة والبروتين، كما تم قياس التوصيل الكهربى و قياس اللون.

أثبتت نتائج التجارب وجود نسبة مقدرة من المواد الفينولية ومضادات الأكسدة فى العسل السودانى تراوحت ما بين 201.1-4.4 mg/TAE/100 g honey للمواد الفينولية. أعلى نسبة للمواد الفينولية وجدت 146.38 mg/TAE/100 g honey فى عسل السنط 201.1 mg/TAE/100 g honey 67.1 ثم عسل الطلح 20.15 mg/TAE/100 g honey 17.15 عسل النيم 21.98. أما عينتى عسل الصدر الجبلى والصدر فأظهرت نتائج متقاربة 20.15 mg/TAE/100 g honey 17.15 عسل النيم 21.98. وأظهر عسل القرع أقل نسبة تراوحت ما بين 4.4 mg/TAE/100 g honey وأن الوزن الجاف للعيضة اللازم لإحداث 6247-3177 µg تثبيط للأكسدة بنسبة 50% تراوح ما بين 3177 µg يأتى بعده عسل الهجليج 4068 µg، 4045 µg عسل الصدر، ثم عسل الطلح 4679 µg ثم عسل الصدر 4068 µg، 4045 µg عسل السنط كان تأثيره الأقل لنشاط مضادات µg الجبلى أظهر نشاط متوسط 5125 µg يليه عسل القرع 5323 µg، 6247 µg الأكسدة.

فى المواد الفينولية ($P < 0.01$) أظهرت النتائج إختلاف عالى المعنوية للعينات المختلفة؛ كما أثبتت نتائج التحليل التى أجريت لمعرفة العلاقة بين ($P > 0.05$) المواد الفينولية ومضادات الأكسدة أنها ليست معنوية.

أخذت تراكيز مختلفة (5، 25 و 50 ميكرو لتر) من كل عينة وحسبت النسبة المئوية لتثبيط عملية الأكسدة و قد لوحظ أن النسبة المئوية تزداد بزيادة التركيز. أيضاً أجرى تحليل للنتائج لمعرفة إن كان هناك علاقة بين النسبة المئوية والتركيز حيث أكدت النتائج وجود علاقة موجبة.

نتائج البروتين والمواد الصلبة الذائبة والتوصيل الكهربى كانت ضمن المواصفات القياسية لعسل النحل حيث تراوحت ما بين 0.286-0.200، 79.0-75.2 و 0.80-0.20 % على التوالى. نتائج نسبة الرطوبة، الرقم الهيدروجينى، معامل الإنكسار ونسبة الرماد تراوحت بين 21.27-16.20، 4.80-3.70، 1.4960-1.4833 و 1.205-0.1207 % على التوالى، وهذه بين العينات المختلفة ($P < 0.01$) النتائج أظهرت إختلاف عالى المعنوية.

ولمعرفة العلاقة بين نسبة الرطوبة ونسبة المواد الصلبة الذائبة أظهرت ($P > 0.05$) ذات تأثير معنوى ($r = -0.869$) الدراسة وجود علاقة سالبة بينهما. تم قياس اللون للعينات المختلفة بإستخدام جهاز قياس اللون وكانت L^* النتائج كالآتى 59.44-24.47، -8.41-1.26، و 22.02-2.40 لكل من على التوالى. كما تم حساب القيم التالية 22.30-2.70، -62.68، a^* ، b^*

89.51 و 82.35-11.76 والتى تدل على درجة اللون، زاوية تدرج اللون ومؤشر التحول البنى على التوالي.