

Effect of Black Dates on Iron Deficiency Anemia of Orphan Children

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ABSTRACT

Iron deficiency anemia represents a major public health problem, particularly in infants, young children and women. Therefore, this study was aimed to evaluate the effect of black dates on children suffering from iron deficiency anemia living in orphanage. Forty male children (9-11 years) were divided into four equal groups. Non-anemic groups include positive control group, date with hulls group and date without hulls group (ingested 10 dates daily for 8 weeks). The energy, protein, carbohydrate, fat, fiber, vitamins and minerals intake of non-anemic groups compared with Dietary Reference Intakes (DRI) were evaluated. The anthropometric measurements and hematological parameters during the experiment period were also evaluated. Anemic groups did not consume protein however; energy and fiber were approximately similar to the DRI values. Non-anemic group and anemic group had lower thiamin, vitamin A, vitamin E, calcium and phosphorus intake than DRI values. Iron and zinc was higher in non-anemic group compared with DRI values while anemic groups had an opposite trend. Date without hulls group had higher weight and body mass index than non-anemic group and date with hulls group. Hemoglobin, haematocrit, mean corpuscular volume, mean corpuscular hemoglobin, serum iron, serum ferritin and transferrin saturation in black date groups were increased by increasing the experiment period while total iron binding capacity had an opposite trend. Date without hulls group was more effective than date with hulls group in improving serum iron, serum transferrin saturation and total iron binding capacity.

Key words: Orphanage children, anemia, hemoglobin and dietary intake.

INTRODUCTION

Iron-deficiency anemia is a worldwide public health problem, affect both developed and developing countries, with serious consequences to human health and the socio economic development of countries (Yurdakök et al., 2004). It affects approximately 30% of the world's population (Gasche et al., 2004). Although anemia has a variety of causes, anemia due to iron deficiency represents 50% of these causes (Black et al., 2003). The main risk factors for iron deficiency among young children are low intake and the high requirement of iron during child growth (Soliman et al., 2009 and Falkingham et al., 2010). Iron deficiency anemia develops when available iron is insufficient to support normal red cell production which is the most common type of anemia. Common causes of iron deficiency include inadequate intake of dietary iron, inadequate iron utilization during chronic and inflammatory diseases, impaired iron absorption, or excess iron loss (Santiago, 2012). Iron supplement or an iron-fortified food with added micronutrients will have a beneficial effect on hemoglobin status in children at risk of micronutrient deficiencies (Rosado et al., 2010). Iron supplements are useful for production of a rapid improvement in the iron status in anemic individuals (Tang et al., 2015). Several substitutions are available for prevention

and/or treatment of anemia. Rice fortification is an effective intervention strategy to correct iron deficiency in children under 5 years old (Falkingham et al., 2015). Ingestion of germinated fava beans reduced anemia in children 6-8 years old (Mancy, 2008). Therefore, this study was aimed to evaluate the effect of black dates with or without hulls as a plant source of iron on children suffering from iron deficiency anemia living in orphanage.

MATERIALS AND METHODS

Black dates were purchased from local market of Shibin El-Kom, Minufiya, Egypt.

All ethical concerns required for this research have been considered before we started the research. Also, approvals from Faculty of Home Economics, Minufiya University, and Mini Solidarity as well as orphanage in Shibin El-Kom, Egypt were received before conducting the research.

Subjects design

Eighty male children aged from 9-11 years were randomly selected from two orphanages in Shibin El-Kom, Minufiya, Egypt. At the beginning of the experiment, a 5 ml of their blood sample was collected to determine hemoglobin (Hb), hematocrit (Ht), red blood cell (RBC), serum iron (SI), serum ferritin (SF) and total iron binding capacity (TIBC). As the obtained data basis, forty children

divided into four equal groups. The first group was non-anemic group (negative control group), the second, third and fourth groups were anemic groups. The second group was positive control group (untreated), the third and the fourth anemic groups were given black dates with or without hulls (100g black date / daily for 8 weeks), respectively. Anemic groups were diagnosed as iron deficiency anemia with cutoff point of anemia indices less than 11g/dl, 30 µg /dl and 27 fl for hemoglobin, ferritin and mean corpuscular hemoglobin (MCH), respectively. After 4 and 8 weeks, blood samples were collected to evaluate the hematological parameters.

Anthropometric Measurements

Weight was measured to the nearest 0.1 kg with an electronic scale, children wore light clothes and without shoes. Children height was measured to the nearest 0.1 cm. The body mass index (BMI) was calculated from the following equation:

$$\text{BMI} = \text{weight (kg)} \div \text{square of height (m)}$$

The mean height for age and BMI for age Z-scores were compared to the WHO (2007) reference values.

Food intake was recorded for 3 days, including week end day and the previous or next 2 days (Wednesday, Thursday, Friday or Friday, Saturday, Sunday). Energy and nutrients intakes were calculated by using a computer program based on the food composition table (1996) of the *National Institute of Nutrition*. Results were compared with Dietary Reference Intakes (DRIs, 2003).

Analytical Methods

Proximate chemical composition

Moisture, fat, protein, ash, fiber and Fe of dates with and without hulls, were determined according to the method of AOAC, (1990). The carbohydrates were calculated by difference.

Hematological parameters

Hemoglobin (Hb) red blood cell (RBC) and hematocrit (Ht) of heparinized blood samples were measured using automated hematology analyzer (Sysmex, Kobe, Japan). Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and transferrin saturation (TS) were calculated by Lee and Nieman, (1996) according to the following equations:

$$\text{MCV} = \frac{\text{Ht}}{\text{RBC}} \times 10$$

$$\text{MCH} = \frac{\text{Hb}}{\text{RBC}} \times 10$$

$$\text{TS (\%)} = \frac{\text{SI}}{\text{TIBC}} \times 100$$

Statistical Analysis

The experimental data were subjected to an analysis of variance (ANOVA) for a completely randomized design using a statistical analysis

system SAS, (2000). Duncan's multiple range test were used to determine the differences between means at the level of 95%.

RESULTS AND DISCUSSION

Proximate chemical composition, iron and vitamin C contents of black dates with and without hulls are presented in Table (1). There were no significant ($P > 0.05$) differences in moisture, carbohydrate between black dates with and without hulls. Black dates with hulls had higher iron, fiber, ash, iron and vitamin C contents, while lower ($P \leq 0.05$) protein and fat contents as compared with black dates without hulls. El Shorbagy, (2004) reported that black date had high contents of iron (9.94%), carbohydrate (69.4%), fiber (11.1%) and iron content (166.5mg/100g) (on dry basis). Fat (1.45%) was low. Al-Shahib and Al-Sayid (2003) reported that the chemical composition of black dates were 44-88%, 0.2- 0.5%, 2.3- 5.6% and 11.5% for carbohydrate, fat, protein and iron respectively. The date pulps are rich in calcium, cobalt, copper, fluorine, magnesium, manganese, potassium (Al Farsi and Lee, 2004; Mohamed and Khamis, 2004).

Energy and dietary macronutrients in non-anemic and anemic groups are shown in Table (2). No significant differences ($P > 0.05$) were found in energy and carbohydrate between non-anemic and anemic groups. However, non-anemic group had a higher ($P \leq 0.05$) protein content than anemic group. The positive control group, date with hulls group and date without hulls group did not contain enough protein which less than mentioned by 29.47, 7.53 and 9.15%, respectively. Iron, energy and fiber were approximately similar to DRI values. In orphanage in Shibin El-Kom the daily intake of energy and protein were less than RDA values by 14.4 and 16.4%, respectively (Hussein et al., 2006). However, El Gendy, (2006) reported that orphaned male in Minufiya, covered 69.47% and 100% of RDI from energy and protein intake.

The results showed that the percent energy distribution derived from carbohydrate, protein and fat were 79.2, 6.1 and 14.7%, respectively for non-anemic children, 80.7, 6.1 and 14.9%, respectively for positive group, 81.1, 6.1 and 13.6%, respectively for date with hulls group, 79.2, 5.4 and 15.4%, respectively for date without hulls group. The results also indicated that there was a tendency towards exclusive reliance on carbohydrate because they are bulky thus giving satiety value cheap. Hussein et al., (2006) found that carbohydrate, protein and fat provided 55.54, 13.6% and 30.23% of total calorie, respectively for children living in orphanage. This difference is due to the food eaten by children in orphanage mainly depends on aids which differ from time to time.

Data in Table (3) show vitamins and minerals intake of non-anemic and anemic groups. Non-anemic group had higher ($P \leq 0.05$) thiamin, riboflavin, vitamin A, vitamin E, calcium, iron and zinc than anemic group, while phosphorus had an opposite trend. Non-anemic group and anemic group had a similar ($P > 0.05$) vitamin C. Anemic group intake date with or without hulls had higher ($P \leq 0.05$) calcium than positive control group; however vitamin A had opposite trend. Groups intake date with or without hulls and positive control group had similar ($P > 0.05$) thiamin, riboflavin, vitamin C and phosphorus.

The mean intake of vitamin A, vitamin E, calcium and phosphorus for non-anemic group and anemic groups were lower than DRI values. The children in this study consumed inadequate of riboflavin, calcium and phosphorus, which are essential for carbohydrate use and essential for bone health, respectively. However, they consume adequate of vitamin C, which is important for iron absorption, and skin health. The low intake of calcium and phosphorus might be due to the low consumption of milk in orphanages, which depends on community aid. Anemic children had lower iron and zinc (5.66- 5.96 and 5.95-6.29 mg/d respectively) than DRI value (8 mg/d). The mean iron and zinc values were lower than DRI values by (25.5 and 21.38%) for positive group, (29.25 and 25.63%) for dated with hulls and (28 and 21.63%) for dates without hulls, respectively. Hussein et al., (2006) reported that the daily intake of vitamin A and Ca for orphanage children were lower than RDI by 52.6 and 43.3%, respectively. El Gendy, (2000) found shortage in calcium and magnesium intakes in Minufiya orphanage as compared with RDI.

Data in Table (4) show the anthropometric measurements of non-anemic and anemic groups. There were no significant ($P > 0.05$) differences in height and age between of non-anemic and anemic groups. Positive control group and date without hulls group had higher ($P \leq 0.05$) weight and BMI than non-anemic group and date with hulls group. On the other hand, no significant ($P > 0.05$) differences were found in weight and BMI between non-anemic group and date with hulls group. Comparison to WHO (2007) reference values, height for Z-score (HAZ) and BMI for Z-score (BMI Z-score) values, the HAZ value refer to normal between 0 and +1SD for all groups. However BMI Z-score values refer to overweight between + 1 and + 2SD for non-anemic and date with hulls groups and obese $> +2SD$ for positive control and date without hulls groups. This observation might be due to increase the carbohydrate intake and or decrease the physical activity. Karim and Zahid, (2012) reported that the HAZ for 89% of orphan children was normal and 21% was overweight in Dhaka city in Bangladesh.

The classification of BMI in orphanage of El-Kom, Egypt reveals that 50% of male children were in normal weight (Hussein et al., 2006).

Table (5) shows the effect of black date: Hb, Ht, RBC, MCV and MCH of non-anemic groups. The levels of Hb, Ht, RBC and MCH in anemic groups were significantly ($P \leq 0.05$) lower than non-anemic group with exception of MCV for anemic groups ingested date for 8 weeks which was similar to ($P > 0.05$) anemic group.

At zero time, Hb, Ht, RBC, MCV and MCH of positive control group were similar ($P > 0.05$) to anemic groups ingested black dates with or without hulls. However after 4 and 8 weeks, their levels of Hb, Ht, RBC and MCH of positive control group were significantly ($P \leq 0.05$) lower than anemic groups ingested black dates with or without hulls with exception of RBC for 4 weeks which was similar to ($P > 0.05$) anemic groups ingested black dates. The results indicated that black dates enhanced Hb, Ht, MCV and MCH after 4 weeks of experiment period. These increments might be due to improve in iron intake of ingested black dates with or without hulls. Black dates had a positive effect on hematological parameters. Abdel-Rahman et al., (2008) reported that the levels of Hb were improved in Egyptian child females after ingesting 100g daily black dates for 8 weeks. These results are in agreement with Hernandez et al., (2006) and Sazawal et al., who reported that increased Fe intake resulted in an increment of Hb concentration.

There were no significant ($P > 0.05$) differences in hematological parameters under study between date with hulls group and date without hull group with the exception of Ht for date without hulls group for 8 weeks which was higher ($P \leq 0.05$) than date with hulls group for 8 weeks.

Table (6) shows the effect of black date: SF, TIBC and TS of non-anemic and anemic groups. Non-anemic children had higher ($P \leq 0.05$) SI, SF and TS than anemic children with exception of SF for anemic children ingested date without hulls for 8 weeks which was similar ($P > 0.05$) non-anemic children. Anemic children had higher ($P \leq 0.05$) TIBC than non-anemic children during the experiment period.

At zero time, anemic children ingested black dates had higher ($P \leq 0.05$) SI and TS than positive control group, while TIBC had an opposite trend. There was no significant ($P > 0.05$) difference between positive control group and date group as well as there were no significant ($P > 0.05$) differences in SI, SF and TS between date with hulls group and date without hulls group. However in date with hulls group was lower ($P \leq 0.05$) than date without hulls group.

After 4 and 8 weeks, anemic children ingested black dates with or without hulls had higher ($P \leq 0.05$) SI, SF and TS than positive control group, while TIBC had an opposite trend. The TIBC in black date groups was decreased by increasing the experiment period. Date without hulls group was more effective ($P \leq 0.05$) than date with hulls group in improving SI, SF, TS and TIBC with the exception of SF for 4 weeks which was similar ($P > 0.05$) in the two groups. This observation might be due to the high fiber content in dates with hulls, which had a negative effect in iron absorption. These results are in agreement with Abdel-Rahman et al., (2008) who reported that black dates improved the levels of Hb, SI and SF in anemic Egyptian female's childbearing. Rosado et al., (2010) found that supplementation children (6-43 months) for 4 months with iron enhanced the levels of SI, SF and TIBC. Fortified milk consumption compared to consumption of control milk, resulted in an increase in mean body iron stores (SF) and a significant reduction in mean total iron binding capacity (Sazawal et al., 2010).

CONCLUSION

Finally it can be concluded that, iron from black dates with or without hulls is cheap, safe, and effective in improving hemoglobin levels and restoring iron stores to correct iron deficiency anemia.

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1-Yield/vine:

Data in Table (1) clearly show that spraying clusters of Early sweet grapevines with GA₃ at 10 to 40 ppm or Sitofex at 2.5 to 10 ppm was significantly effective in improving the yield relative to the check treatment. The promotion on the yield was accompanied with increasing concentrations of each plant growth regulator. Using GA₃ at 10 to 40 was significantly preferable than using Sitofex at 2.5 to 10 ppm in improving the yield. A slight and insignificant promotion on the yield was attributed to increasing concentrations of GA₃ from 20 to 40 ppm and Sitofex from 5 to 10 ppm. The maximum yield was produced on the vines that received one spray of GA₃ at 40 ppm but the best treatment from economical point of view was the application of GA₃ at 20 ppm (since no measurable promotion on the yield was recorded between 20 and 40 ppm of GA₃). Under such promised treatment, yield/vine reached 13.6 and 14.0 kg during both seasons, respectively. The control vines produced 9.1 and 9.6 kg during 2013 and 2014 seasons, respectively. The percentage of increase on the yield due to application of GA₃ at 20 ppm over the check treatment reached 49.5 and 45.8 % during both seasons, respectively. The beneficial effects of GA₃

on the yield might be attributed to their action on increasing cluster weight. The positive effects of GA₃ on the yield was supported results of Dimovska et al., (2011) and Abu and Salameh (2012) on different grapevine cultivars. The results regarding the beneficial effect of Sitofex on enhancing the yield are in harmony with those obtained by Juan et al. (2009); Abdel-Rahman et al., (2010) and Al-Obeid (2011).

2-Harvesting date:

It is clear from the data in Table (1) that GA₃ and Sitofex treatments had significantly delayed the harvesting date of Early Sweet grapevine than the control treatment. The degree of delay on harvesting date was correlated to the increase in the concentrations of both GA₃ and Sitofex. GA₃ significantly delayed harvesting date comparing with using Sitofex. In concentrations of GA₃ from 20 to 40 ppm and Sitofex from 5 to 10 ppm failed to show significant delay on harvesting date. A considerable advancement on harvesting date was observed on untreated vines. The great delay on harvesting date was observed on the vines that received GA₃ at 40 ppm during both seasons. GA₃ and Sitofex shown by many authors to retard the ripening of ethylene and the disappearance of pigments chlorophylls and carotenoids and onset of ripening. Also they were responsible for prolonging maturity stages (Nickell (1985)). These results regarding the delaying effect of GA₃ and Sitofex on harvesting date were in harmony with those obtained by Wassel et al., (2007); Kasser et al. (2011); Abu Zahra and Salameh (2012) and Dimovska et al. (2012).

3-Cluster weight and dimensions:

It is evident from the data in Table (1) that treating clusters with GA₃ at 10 to 40 ppm and Sitofex at 2.5 to 10 ppm was significantly accompanied with enhancing weight, length and width of cluster relative to the control treatment.

The promotion was significantly associated with increasing concentrations of GA₃ and Sitofex. GA₃ was significantly favourable than using Sitofex in this respect. The maximum values were found on the vines that received one spray of GA₃ at 20 ppm. Meaningless promotion was detected with increasing concentrations of GA₃ from 20 to 40 ppm and Sitofex from 5 to 10 ppm. The untreated vines produced the minimum values during both treatments. The positive action of GA₃ on cluster weight and dimensions might be attributed to its essential role in stimulating cell division and enlarging cells, the water absorption and the biosynthesis of proteins which will lead to increase berry yield (Dimovska *et al.*, (2011); Abu Zahra and S. (2012) and Dimovska *et al.*, (2014)).

The previous essential role of CPPU on cluster weight was attributed to its higher content of cytokinin when applied to plants (Nickell, 1985).

4- Shot berries %:

Data in Table (2) obviously reveal that percentage of shot berries in the clusters of Early Sweet grapevines was significantly controlled with spraying GA₃ at 10 to 40 ppm or Sitofex at 2.5 to 10 ppm relative to the check treatment. Using GA₃ was preferable than using Sitofex in reducing the percentages of shot berries. There was a gradual reduction on the percentage of shot berries with increasing concentrations of GA₃ and Sitofex. There was a slight reduction on such unfavourable phenomenon with increasing concentrations of GA₃ from 20 to 40 ppm and Sitofex from 5 to 10 ppm. The minimum values of shot berries (7.3 and 6.9 % during both seasons, respectively) were recorded on the clusters harvested from vines treated with GA₃ at 40 ppm. The maximum values of shot berries (12.0 & 12.5 %) during both seasons were recorded on the untreated vines during both seasons. The reducing effect of GA₃ on shot berries might be attributed to its important role on enhancing cell division and the biosynthesis of proteins Nickell, (1985). These results were supported by the results of wassel *et al.* (2007) and Abu Zahra and Salameh (2012).

5- Fruit quality:

Data in Tables (2, 3 & 4) clearly show that spraying clusters with GA₃ at 10 to 40 ppm or Sitofex at 2.5 to 10 ppm significantly was accompanied with enhancing weight, longitudinal and equatorial of berry, total acidity%, proteins % and percentages of P, K and Mg and T.S.S. %, reducing sugars %, T.S.S. / acid and total carotenoids relative to the check treatment. The effect either increase or decrease was associated with increasing concentrations of each auxin. Using GA₃ significantly changed these parameters than using Sitofex. A slight effect was recorded on these quality parameters with increasing concentrations of GA₃ from 20 to 40 ppm and Sitofex from 5 to 10 ppm. From economical point of view, the best results with regard to fruit quality were observed due to treating clusters with GA₃ at 20 ppm. Untreated vines produced unfavourable effects on fruit quality. These results were true during both seasons. The effect of GA₃ on increasing berry weight and dimensions might be attributed to its effect in promoting cell division and enlargement of cells, water uptake and the biosynthesis of proteins Nickell (1985). These results were in concordance with those obtained by Williams and Ayars (2005) and Dimovska *et al.*, (2014).

The higher content of Sitofex from cytokinins surely reflected on enhancing cell division and the elongation of berries Nickell (1985). These results

were in agreement with those obtained by Zahra (2013) and Retamales *et al.* (2015).

CONCLUSION

Treating Early Sweet grapevines once w average berries reached 6mm with GA₃ at was responsible for promoting yield an quality.

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الملخص العربي

تأثير البلح الاسود علي انيميا نقص الحديد لاطفال الملاحي

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~~مصطفى علي مجاور عبادة، ماهر خيرى يواقيم، بسام السيد عبد المقصود بالال~~

~~قسم بحوث العنب = معهد بحوث البساتين = مركز البحوث الزراعية = الجزيرة = مصر~~

ن أنيميا نقص الحديد مشكلة صحية عامة رئيسية، خاصة عند الرضع والأطفال الصغار والنساء الحوامل. لذلك
ذه الدراسة إلى تقييم تأثير البلح الاسود على الأطفال الذين يعانون من انيميا نقص الحديد و يعيشون في دار
نمليت الدراسة أربعين طفلا من الذكور تراوحت اعمارهم (9-11 عام) تم تقسيمهم إلى أربع مجموعات متساوية.
غير مصابة بالانيميا، مجموعات مصابة بالانيميا وتشمل مجموعة كنترول موجبة، مجموعة البلح بقشرة
ة البلح بدون قشرة (تناولت 100 جم بلح اسود/ يوميا لمدة 8 اسابيع). تم تقييم المتناول من الطاقة، البروتين،
رات، الدهون، الألياف، الفيتامينات والمعادن لكلا من المجموعة المصابة والغير مصابة بالانيميا ومقارنتهم

I. ايضا تم تقييم القياسات الجسمية وقياسات الدم خلال فترة التجربة. اظهرت النتائج ان المجموعة المصابة لم يحصلوا علي كمية كافية من البروتين بينما الطاقة والألياف كانت مماثلة تقريبا لقيم DRI. كما لوحظ ان ة المصابة والغير مصابة بالانيميا قد حصلوا علي محتويات أقل من النيامين، فيتامين A، فيتامين E، والفوسفور مقارنة بقيم DRI. هذا وقد وجد ان الحديد والزنك كان أعلى في المجموعة الغير مصابة مقارنة مع بينما اخذت المجموعات المصابة اتجاه معاكس. مجموعة البلح بدون قشر كانت أعلى في الوزن ومؤشر كتلة ن المجموعة الغير مصابة بالانيميا ومجموعة البلح بقشرة. لوحظ ان الهيموجلوبين، الهيماتوكريت، خلايا الدم متوسط حجم الكرية الوسطي، متوسط حجم هيموجلوبين كرية الدم الحمراء، وحديد السيرم، فيريتين السيرم ترانسفيرين في مجموعات البلح الاسود قد زادت مع زيادة فترة التجربة في حين أن سعة ارتباط الحديد الكلية تجاهها معاكس. كما وجد ان مجموعة البلح بدون قشر كانت أكثر فعالية من مجموعة البلح بقشرة في تحسين يرم، فيريتين السيرم، تشبع الترانسفيرين وسعة ارتباط الحديد الكلية.

الدليلية: أطفال ملاجئ، انيميا، هيموجلوبين والمتناول الغذائي

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