Effect of Black Dates on Iron Deficiency Anemia of Orphanage Children

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ABSTRACT

Iron deficiency anemia represents a major public health problem, particularly in infants, young children and pregnant 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 (9-11years) were divided into four equal groups. Non-anemic group, anemic groups include positive control group, date with hulls group and date without hulls group (ingested100g black dates daily for 8 weeks). The energy, protein, carbohydrate, fat, fiber, vitamins and minerals intake of non-anemic and 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 enough protein however; energy and fiber were approximately similar to the DRI values. Non-anemic group and anemic groups 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, red blood cell, 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 ferritin, 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 (Santiage, 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 was an effective intervention strategy to correct iron deficiency in children under 5 years old (Hijar, et al., 2015). Ingestion of germinated fenugreek reduced anemia in children 6–8 years old (El 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 human research have been considered before we start this research. Also, approvals from Faculty of Home Economic, Menufiya University, and Ministry of Solidarity as well as orphanage in Shibin El Kom, Egypt were received before conducting this research.

Subjects design

Eighty male children aged from 9-11 years were randomly selected from two orphanages at Shibin El-Kom, Minufiya, Egypt. At the beginning of experiment, a 5 ml of their blood samples were 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 were 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:

BMI= weight (kg) ÷ 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:

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

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

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

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 tests were used to determine the differences among 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 and carbohydrate between black dates with and without hulls. Black dates with hulls had higher ($P\leq0.05$) fiber, ash, iron and vitamin C contents, while it had lower ($P\leq0.05$) protein and fat contents as compared with black dates without hulls. El Shorbagey, (2012) reported that black date had high contents of protein (9.94%), carbohydrate (69.4%), fiber (11.1%) and iron content (166.5mg/100g) (on dry basis) while, fat (1.45%) was low. Al-Shahib and Marshall (2003) reported that the chemical composition of the dates were 44-88%, 0.2- 0.5%, 2.3- 5.6% and 6.4-11.5% for carbohydrate, fat, protein and fiber, respectively. The date pulps are rich in iron, calcium, cobalt, copper, fluorine, magnesium, manganese, potassium (Al Farsi and Lee, 2008 and Mohamed and Khamis, 2004).

Energy and dietary macronutrients intake of 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 ($P\leq0.05$) protein content than anemic group. The positive control group, date with hulls group and date without hulls group did not consume enough protein which less than mentioned in DRI by 29.47, 7.53 ant 9.15%, respectively however, energy and fiber were approximately similar to the DRI values. In orphanage in Shibin El-Kom, Egypt the daily intake of energy and protein were lower than RDA values by 14.4 and 16.4%, respectively (Hussein et al., 2006). However, El Gendy, (2000) reported that orphaned male in Minufiya, Egypt covered 69.47% and 100% of RDI from daily energy and protein intake.

The results showed that the percentage of energy distribution derived from carbohydrate, protein and fat were 79.2, 6.1 and 14.9%, respectively for non-anemic children, 80.7, 4.2 and 14.9%, respectively for positive group, 81.1, 5.5 and 13.6%, respectively for date with hulls group and 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 starches because they are bulky thus giving satiety value and cheap. Hussein et al., (2006) found that carbohydrate, protein and fat provided 55.54, 15.17 and 30.23% of total calorie, respectively for children living in orphanage. This difference may be due to the food eaten by children in orphanages 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 Shibin El-Kom, Egypt reveals that 50% of male children were in normal weight (Hussein et al., 2006).

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

At zero time, Hb, Ht, RBC, MCV and MCH in 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 in 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 8 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 8 weeks of experiment period. These increments might be due to improve in iron intake of groups ingested black dates with or without hulls, which had a positive effect on hematological parameters. Abdel-Rahman et al., (2008) reported that the levels of Hb were improved in Egyptian childbearing females after ingesting 100g daily black dates for 7 weeks. These results are in agreement with those of Hemandez et al., (2006) and Sazawal et al., (2010), who reported that increased Fe intake response with 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 hulls 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 dates on SI, 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 the exception of SF for anemic children ingested date without hulls for 8 weeks which was similar to ($P>0.05$) 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 in SF between positive control group and date groups. 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, TIBC 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 GA_3 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 GA_3 at 10 to 40 was significantly preferable than using Sitofex at 2.5 to 10 ppm in improving the yield. A slight and unsignificant promotion on the yield was attributed to increasing concentrations of GA_3 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 GA_3 at 40 ppm but the best treatment from economical point of view was the application of GA_3 at 20 ppm (since no measurable promotion on the yield was recorded between 20 and 40 ppm of GA_3). 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 GA_3 at 20 ppm over the check treatment reached 49.5 and 45.8 % during both seasons, respectively. The beneficial effects of GA_3 on the yield might be attributed to their positive action on increasing cluster weight. The promoting effects of GA_3 on the yield was supported by the results of Dimovska *et al.*, (2011) and Abu- Zahra and Salameh (2012) on different grapevine cvs.~~

~~The results regarding the beneficial effects of Sitofex on enhancing the yield are in harmony with those obtained by Juan *et al.* (2009); Abdel- Fattah *et al.*, (2010) and Al- Obeed (2011).~~

~~**2- Harvesting date:**~~

~~It is clear from the data in Table (1) that all GA_3 and Sitofex treatments had significantly delayed on the harvesting date of Early Sweet grapevines rather than the control treatment. The degree of delayness on harvesting date was correlated to the increase of the concentrations of both GA_3 and Sitofex. Using GA_3 significantly delayed harvesting date comparing with using Sitofex. Increasing concentrations of GA_3 from 20 to 40 ppm and Sitofex form 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 GA_3 at 40 ppm during both seasons. GA_3 and Sitofex were shown by many authors to retard the release of ethylene and the disappearance of pigments such as chlorophylls and carotenoids and onest of maturity start. Also they were responsible for prolonging pre-maturity stages Nickell (1985). These results regarding the delaying effect of GA_3 and Sitofex on harvesting date were in harmony with those obtained by Wassel *et al.*, (2007), Kassem *et al.* (2011), Abu- Zahra and Salameh (2012) and Refaat *et al.* (2012).~~

~~**3- Cluster weight and dimensions:**~~

~~It is evident from the data in Table (1) that treating clusters with GA_3 at 10 to 40 ppm or 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 GA_3 and Sitofex. Using GA_3 was significantly favourable than using Sitofex in this respect. The maximum values were recorded on the vines that received one spray of GA_3 at 40 ppm. Meaningless promotion was detected with increasing concentrations of GA_3 from 20 to 40 ppm and Sitofex from 5 to 10 ppm. The untreated vines produced the minimum values during both seasons. The positive action of GA_3 on cluster weight and dimensions might be attributed to its essential role on stimulating cell division and enlargement of~~

~~cells, the water absorption and the biosynthesis of proteins which will lead to increase berry weight. Dimovska *et al*., (2011); Abu- Zahra and Salameh, (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 GA_3 at 10 to 40 ppm or Sitofex at 2.5 to 10 ppm relative to the check treatment. Using GA_3 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 GA_3 and Sitofex. There was a slight reduction on such unfavourable phenomenon with increasing concentrations of GA_3 form 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 GA_3 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 GA_3 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 GA_3 significantly changed these parameters than using Sitofex. A slight effect was recorded on these quality parameters with increasing concentrations of GA_3 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 GA_3 at 20 ppm. Untreated vines produced unfavourable effects on fruit quality. These results were true during both seasons. The effect of GA_3 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 surly reflected on enhancing cell division and the elongation of berries Nickell (1985). These results were in agreement with those obtained by Abu-Zahra (2013) and Retamales *et al*. (2015).~~

~~CONCLUSION~~

~~Treating Early Sweet grapevines once when the average berries reached 6mm with GA_3 at 20 ppm was responsible for promoting yield and fruit quality.~~

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الملخص العربى

تأثير البلح الاسود علي انيميا نقص الحديد لاطفال الملاجئ

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تمثل أنيميا نقص الحديد مشكلة صحية عامة رئيسية، خاصة عند الرضع والأطفال الصغار والنساء الحوامـل. لذلك هدفت هذه الدراسة إلى تقييم تأثير البلح الاسود على الأطفال الذين يعانون من انيميا نقص الحديد و يعيشون في دار للأيتام. شملت الدراسة أربعين طفلا من الذكورتراوحت اعمارهم (٩–١١عام) تم تقسيمهم إلى أربع مجموعـات متساوية. مجموعة غير مصابة بالانيميا، مجموعات مصابة بالانيميا وتشمل مجموعة كنترول موجبة، مجموعة البلح بقشرة ومجموعة البلح بدون قشرة(تناولت ١٠٠جم بلح اسود/ يوميا لمدة ٨ اسابيع). تم تقييم المتناول من الطاقـة،

البروتين، الكربوهيدرات، الدهون، الألياف، الفيتامينات والمعادن لكلا من المجموعة المصابة والغير مصابة بالانيميا ومقارنتهم بقيم DRI. ايضا تم تقييم القياسات الجسمية وقياسات الدم خلال فترة التجربة. اظهرت النتائج ان المجموعة المصابة بالانيميا لم يحصلوا علي كمية كافية من البروتين بينما الطاقة والألياف كانت مماثلة تقريبا لقيم DRI. كما لوحظ ان المجموعة المصابة والغير مصابة بالانيميا قد حصلوا علي محتويات أقل من الثيامين، فيتامين A، فيتامينE، الكالسيوم والفوسفورمقارنة بقيم DRI. هذا وقد وجد ان الحديد والزنك كان أعلى في المجموعة الغير مصابة مقارنة مع قيم DRI بينما اخذت المجموعات المصابة اتجاه معاكس. مجموعة البلح بدون قشر كانت أعلى في الوزن ومؤشر كتلة الجسم من المجموعة الغير مصابة بالانيميا ومجموعة البلح بقشرة. لوحظ ان الهيموجلوبين، الهيماتوكريت، خلايا الدم الحمراء، متوسط حجم الكرية الوسطي، متوسط حجم هيموجلوبين كرية الدم الحمراء، وحديد السيرم، فيريتين السيرم وتشبع الترانسفيرين في مجموعات البلح الاسود قد زادت مع زيادة فترة التجربة في حين أن سعة ارتباط الحديد الكليه كان له اتجاها معاكس. كما وجد ان مجموعة البلح بدون قشر كانت أكثر فعالية من مجموعة البلح بقشرة في تحسين حديد السيرم، فيريتين السيرم، تشبع الترانسفيرين وسعة ارتباط الحديد الكليه.

الكلمات الدليلية: أطفال ملاجئ، انيميا، هيموجلوبين والمتناول الغذائي