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Treatment of iron deficiency anaemia with the natural hematinic Carbaodeim*

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ABSTRACT

Iron deficiency anaemia is frequently seen in the paediatric age group. Modifying the treatment options according to the affected area resources will help accessibility and compliance to treatment. Response of children with Iron deficiency anaemia to a natural hematinic (Carboadeim) versus iron syrup plus folic acid treatment was compared in this study.

This is a prospective, interventional, controlled, hospital-based study conducted among children with iron deficiency anaemia residing in Hussein Village, Gezira State who attended Giad Hospital. Patients were randomly divided into two groups; the control received iron supplements and folic acid, and the case received a combination of carrots, baobab (Adansonia digitata) and godeim (Grewia tenax) which is known as (Carboadeim). Blood tests were taken for investigations at start of treatment, after 7- 10 days, 6 weeks and 3 months. Complete blood count, reticulocyte count and serum ferritin were taken as indicators.

The mean haemoglobin level initially in the cases and controls was 7.38 and 7.35 gm/dL, respectively; after three months the mean was 11.67 and 11.384 gm/dL, respectively. The mean serum ferritin in the case and control groups was found to be 10.30 and 10.87 ng/ml, respectively at the start of treatment; and after 3 months they were reported to be 44.34 and 75.7 ng/ml confirming the positive response to treatment by Carboadeim. In conclusion Carboadeim is a naturally available and cost-effective hematinic blend that might be added to the food menu as a supplement as well as a treatment of nutritional anaemia in children.

Keywords:

Iron deficiency anaemia; Natural hematinic; Carbaodeim.

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INTRODUCTION

Iron deficiency (ID) is the most common nutritional deficiency in children. The World Health Organization (WHO) estimates that anaemia affects one quarter of the world's population and is concentrated within pre-school age children and women. Iron deficiency is a particularly challenging problem for developing nations in Asia and Africa [1]. Rates of iron deficiency in the United States and other resources-rich countries are somewhat lower and are gradually improving, but iron deficiency is still common and can have important consequences to health and development [2].

The United States Department of Health and Human Services has set a target of reducing iron deficiency by 10 % by 2020 [3]. Despite the decrease in prevalence of iron deficiency over the last decade, reaching this goal will be challenging, especially in children who are at-risk for iron deficiency [4].

Diagnostic tests for severe iron deficiency anaemia (IDA) includes haemoglobin (Hb) concentration (less than 7gm/dL), mean corpuscular volume (MCV), red cells distribution width (RDW), reticulocyte count and screening stools for occult blood. Additional laboratory testing in children with complicated medical histories includes serum iron, ferritin, total iron-binding capacity, transferrin saturation as well as tests of several stool samples for occult blood [5-7].

Carbaodeim is a natural hematinic blend, which is formed of carrots, baobab (Adansonia digitata) and godiem (Grewia tenax) and proved to have high content of iron, folic acid, vitamin C and protein. Carrot is a root vegetable that can be eaten fresh or cocked (Figure 1). It contains high levels of vitamins A, C, K and folic acid (Table 1) [8]. Baobab (Adansonia digitata) is a dry fruit that has an ovoid shell with a white pulp enclosed within hard fibrous locules. Locally, it is called Gonglaize and Tabaldi. The tree Adansonia digitata, has a huge and capacious stem. Boabab has a high level of calcium, phosphorous, potassium, iron, ascorbic acid and thiamine [9].

Figure 1 - Carbaodeim volume measures used in the study

Table 1 - Element composition of Carbaodeim*

	Carrots 100 gm	**Baobab 100 gm**	**Godeim 100 gm**	Grand total	Total with 25 gm carrots	RDA* *
Vit A (µg)	28000			28000	7000	400
B6 (mg)	0.14			0.14	0.03	0.9 – 1.3
Vit K (µg)	13.2			13.2	3.3	
K (mg)	910	283	1400	2593	1910.5	
Na (mg)	910 mg	27.9 mg	9.7 mg	947.6 mg	265.1 mg	
Protein (gm)	4 -5 gm	3.2 gm	5.6 gm	12.8 -13.8 gm	9.8 -10.6 gm	
Fat (gm)	0.19 gm	0.3 gm	0.52 gm	1.01 gm	0.87 gm	
CHO (gm)	10.14 gm	76.2 gm	63.7 gm	150.04 gm	142.42 gm	
Ca (mg)	27 mg	295 mg	595 mg	917 mg	896.65 mg	800 mg
Ph (mg)	44 mg	50.8 mg	85 mg	179.8 mg	146.8 mg	800 mg
Mg (mg)	15 mg	90 mg	167 mg	272 mg	260.7 mg	150 -200 mg
ZN (mg)		1.8 mg	1.9 mg	3.7 mg	3.7 mg	10 mg
Fe (mg)		9.3 mg	21 -30 mg	30.3 -39.3 mg	30.3 -39.3 mg	
Vit C (mg)	9.3 mg	300 mg	70.25 mg	379.55 mg	372.55 mg	
Folic Acid (mg)	14 mg			14 mg	3.5 mg	

*Swar and Osman [9]

**RDA (recommended daily allowance)

Godiem (Grewia tenax) is a fruit collected from the shrub, Grewia tenax, that grows in Savanna and heavy rain regions. It has a high carbohydrate content of starch and reducing substances, pectin, iron, potassium and calcium [10].

The objective of this study was to assess the response of anaemic children to treatment with Carbaodeim compared to the classical iron plus folic acid therapy.

MATERIALS AND METHODS

This is a prospective, interventional, controlled hospital-based study conducted during the period from September 2014 to February 2015. The study was carried out in Hussein village near Giad town and hospital. It is a small village with a population of around two thousands which has been noticed to have a high incidence of nutritional anaemia. Most residents were farmers and shepherds who have low income and low educational level. Giad Hospital belongs to Giad Industrial Area, south to Khartoum State. It provides health services mainly to the personnel of the company in addition to the surrounding villages. Children attended Giad Hospital, during the study period, were clinically checked for the presence of nutritional anaemia, which was then confirmed with blood tests. Children were equally divided into two groups; 51 (Carbaodeim group), the cases were treated with Carbaodeim according to the dose prescribed by Swar and Osman [9]. The other half, 51 children (the controls) were treated with iron plus folic acid supplements prescribed in the standard doses according to the body weight.

Haemoglobin level was checked at the start of the study, 6 weeks later and after 3 months. Complete blood count was carried out using Sysmex KX 21N® and serum ferritin count was done by Cobas e 411®

analyser.

The Sudanese Medical Specialization Board and the Ethical Committee of Giad Hospital approved the study and all parents consented to the study. Data was entered and analysed using the Statistical Package for Social Sciences (SPSS Version 17).

RESULTS

The total number of children, who fulfilled the criteria for inclusion in this study, was 102. Out of them, 61 were males (59.8%) and 41 females (40.2%) with a male to female ratio of 1.5: 1. Sixty-two (60.8%) were in the age group 1–5 years, 24 in the age group 5–10 years and 16 were less than one-year-old. Ninety-two (90.2%) received ordinary Sudanese diet before age six months. Presenting symptoms included irritability in 80 patients (78.4%), 14 patients (14.14%) had shortness of breath, 9 (8.16%) had palpitations and 96 (94.12%) presented with loss of appetite.

Clinical examinations showed that 82.4% of patients had weight appropriate for age and 82.4% had height appropriate for age. Pallor was detected in 99.0% of the patients, 6.9% had hepatomegaly, 7.8% had splenomegaly, 1.0% presented with cheilosis, 3.9% presented with angular stomatitis, and 4.9% presented with nail spooning. The mean haemoglobin (Hb) level was 7.38 gm/dL initially, 9.73 gm/dL after 6 weeks and 11.67 gm/dL after 3 months on treatment in the cases. In contrast to the mean of Hb level in control group, which was 7.35 gm/dL at the start, 9.06 gm/dL after 6 weeks and 11.38 gm/dL after 3 months on treatment (Table 2).

Table 2 - Haemoglobin concentration in the study group; initially, after 6 weeks and 3 months of treatment with Carbaodeim or iron and folic acid: Time progress vs type of treatment

Timing of haemoglobin measurement	Type of treatment			Haemoglobin concentration (gm/dL)	Standard error
Initially	**Carbaodeim**	Mean		7.38	
		95% CI	Lower Bound	7.04	0.1714
			Upper Bound	7.73	
	Iron and folic acid	Mean		7.35	
		95% CI	Lower Bound	7.06	0.1463
			Upper Bound	7.64	
6 weeks	**Carbaodeim**	Mean		9.73	
		95% CI	Lower Bound	9.31	0.2117
			Upper Bound	10.16	
	Iron and folic acid	Mean		9.06	
		95% CI	Lower Bound	8.68	0.1867
			Upper Bound	9.43	
3 months	Carbaodeim	Mean		11.67	
		95% CI	Lower Bound	11.08	0.2941
			Upper Bound	12.26	
	Iron and folic acid	Mean		11.38	
		95% CI	Lower Bound	10.78	0.3029
			Upper Bound	11.99	

CI - Confidence interval

Increased haemoglobin concentration was recorded in the two groups following treatment; however, it was slightly higher in the cases (Carbaodeim group). The increment in haemoglobin concentration in the two groups was parallel indicating comparable response.

All patients' showed normal total white blood cells (TWBC) and platelets count. The mean reticulocyte count was 1.1% and 0.9% at the start of the study and 4.4% and 4.71% after 7-10 days in the cases and controls, respectively (Figures 2 and 3).

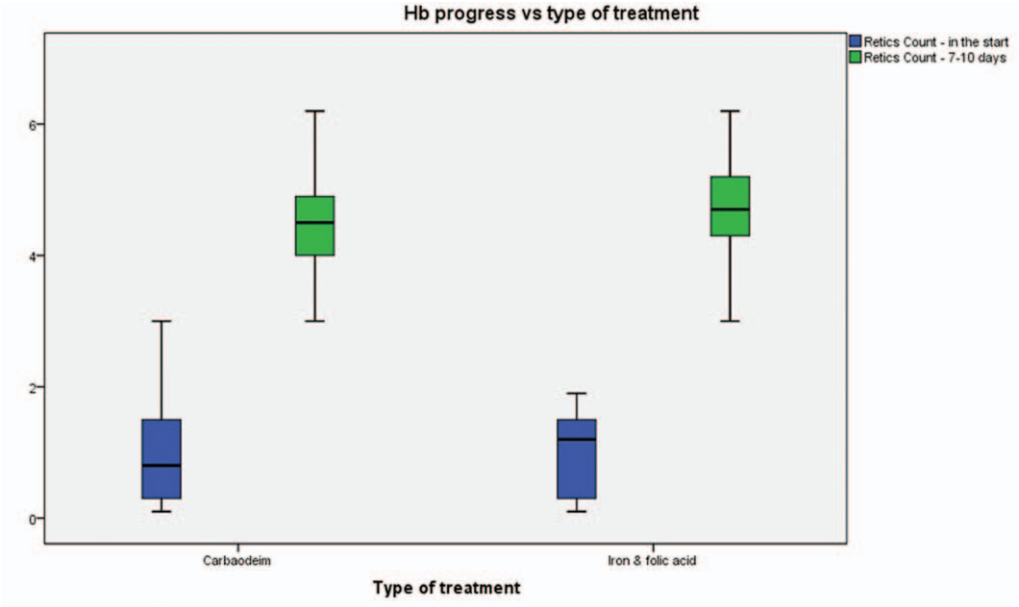

Figure 2 - Haemoglobin concentration comparison between cases (Carbaodeim) and controls (iron and folic acid); initially and after 7-10 days of treatment. Hb – Haemoglobin; Retics – Reticulocyte

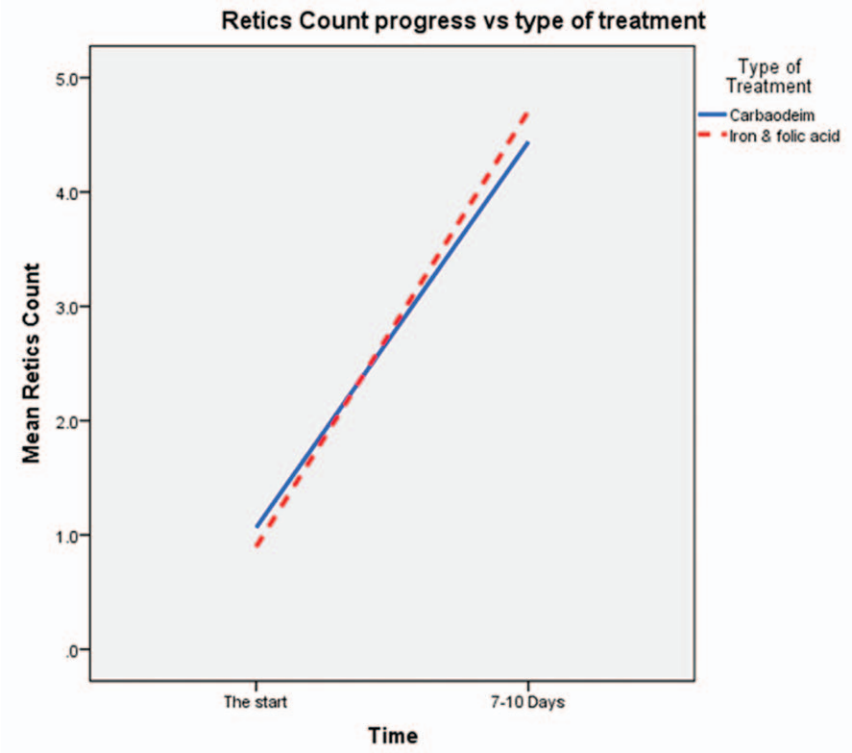

Figure 3 - Reticulocyte count comparison between cases (Carbaodeim) and controls (iron and folic acid); initially and after 7-10 days of treatment.

Likewise, the mean serum ferritin at the start was 10.3 ng/L, 21.6 ng/L after 6 weeks and 55.1 ng/L after 3 months in the cases compared to 10.9 ng/L, 22.1 ng/L and 75.7 ng/L, respectively in the control group (Tables 3 and 4).

Table 3 - Mean serum ferritin level in the cases and controls groups

Serum ferritin level timing	Type of treatment	Serum ferritin (µg/L) Mean+SD	P value
Initially	Carbaodeim	10.302 + 0.4834	0.033c
	Iron and folic acid	11.959 + 0.5448	
At 6 weeks	Carbaodeim	21.569 + .8285	0.893d
	Iron and folic acid	22.098 + 0.6581	
At 3 months	Carbaodeim	55.098 + 5.3588	0.017
	Iron and folic acid	75.706 + 7.6422	

Table 4 - Serum ferritin follow up comparison between cases and controls

Timing of ferritin level	Type of treatment			Seum ferritin (µg/L)	Standard error
Initially	Carbaodeim	Mean		10.30	0.48
		95% CI	Lower Bound	9.33	
			Upper Bound	11.27	
	Iron and folic acid	Mean		11.96	0.54
		95% CI	Lower Bound	10.87	
			Upper Bound	13.05	
At 6 weeks	Carbaodeim	Mean		21.57	0.83
		95% CI	Lower Bound	19.90	
			Upper Bound	23.23	
	Iron and folic acid	Mean		22.09	0.66
		95% CI	Lower Bound	20.78	
			Upper Bound	23.42	
At 3 months	Carbaodeim	Mean		55.09	5.36
		95% CI	Lower Bound	44.34	
			Upper Bound	65.86	
	Iron and folic acid	Mean		75.71	7.64
		95% CI	Lower Bound	60.36	
			Upper Bound	91.06	

Serum ferritin was also found to be compatible with treatment outcome in the two groups indicating positive progress of serum ferritin level. The mean serum ferritin in case and control groups was found to be (10.30 ± 0.48) and (11.96 ± 0.54) µg/L, respectively during start of the study, (21.57 + 0.83) and (22.09 + 0.66) µg/L after 6 weeks, and (55.10 + 5.36) and (75.71 + 7.64) µg/L after 3 months, respectively.

DISCUSSION

The routine management of iron deficiency anaemia depends mainly on medication by iron and folic acid in addition to iron-rich food. The current study attempted to evaluate a naturally available and cost effective new hematinic blend that might be added to the food menu.

Most children were weaned at the age 13-20 months (66.7%) indicating that a considerable percentage of mother ceased breast feeding earlier; the vast majority started introducing cow's milk and unmodified food before 6 months. Impaired psychomotor and/or mental development is well described in iron-deficient infants, and cognitive impairment can occur in adolescents [10,11]. Iron deficiency may also negatively impact infant social-emotional behavior and may contribute to the development of attention deficit hyperactivity disorder [12].

The most obvious signs of IDA noticed was pallor, which was reported in the majority of children (99%) in this study, followed by inadequate weight and height, which was seen in 17.6% of children. Christofides et al., reported similar results showing that IDA in children has been associated with retardation in growth and cognitive development [11].

The outcome of treatment between the control and case groups showed significant improvement in the level of haemoglobin.

Of the limitations that faced the current study, is unavailability of similar or previous studies. A study conducted by Christofides and colleagues in 2013 in Canada showed that, the overall mean haemoglobin increased significantly from 93.2 g/L to 109.5 g/L [11]. On the other hand, Godeim (Grewia tenax) was revealed in previous literature as effective in treatment of iron deficiency as reported by Ahmed et al [12], who documented that Grewia tenax fruit (Godeim) contains large amount of iron and as such is used for treatment of anaemia. Because of its high iron contents, fruits of G. tenax are often used in special diets for pregnant women and anaemic children [11]. A similar study done before by Swar in Sudan documented similar findings.

The association between the initial increases in the mean of haemoglobin in response to iron therapy was found to be comparable to that of carbaodeim therapy [9]. After 6 weeks the association showed significant difference without interrupting the progression rate and this might be due to the good compliance to treatment with carbaodeim.

The reticulocytes count in both groups showed an increase indicating active bone marrow in both groups, and the positive response to treatment in the two groups was also found to be parallel. This result has a significant importance as previous studies showed that reticulocytes survive in the periphery for only one or two days and reticulocyte haemoglobin content (RHC) is a more accurate "real-time" measurement of bone marrow iron status [13]. Similar studies reported that there was a significant association between suitable logarithmic functions of the percentage increase in CHr and ARC at day +3 and the fraction of required Hb increase compared with baseline to reach the mean reference value for age and sex at day 14 [14,15].

Our data is consistent with other studies, which reported that; ferritin is decreased with iron deficiency anaemia and is increased with elevated total body stores of iron [16,17].

According to the findings of the present study, we concluded that the outcome of treatment of IDA with Carbaodeim is similar to treatment with iron plus folic acid. Carbaodeim is a naturally available, easy to prepare and cost-effective hematinic blend that, if added to the food menu, may help prevent early childhood nutritional anaemia especially in areas where drugs are costly, not available or difficult to store.

A wide scale controlled trial with larger cohort and more advanced blood tests, in hospital and community

rehabilitation centers, is recommended to assess acceptability, compliance, efficacy and outcome of using this blend in treatment of IDA in children. The use of Carbaodeim should be part of the health education delivered to different community sectors.

REFERENCES

1. Brittenham GM. Disorders of iron metabolism: Iron deficiency and overload. In: Hematology Basic Principles and Practice, 4th ed, Hoffman R, Benz EJ Jr, Shattil SJ, et al. (Eds), Churchill Livingstone, New York 2005; 481.
2. Beutler E. Disorders of iron metabolism. In: Williams Hematology, 7th ed, Lichtman MA, Beutler E, Kipps TJ, et al. (Eds), McGraw-Hill, New York 2006 ;511.
3. Andrews NC. Forging a field: the golden age of iron biology. Blood 2008; 112(2):219-230.
4. Cook JD. Clinical evaluation of iron deficiency. Semin Hematol 1982; 19(1):6-18.
5. Zhang AS, Xiong S, Tsukamoto H, Enns CA. Localization of iron metabolism-related mRNAs in rat liver indicate that HFE is expressed predominantly in hepatocytes. Blood. 2004; 103(4):1509- 1514.
6. Weizer-Stern O, Adamsky K, Margalit O, Ashur-Fabian O, Givol D, Amariglio N, et al. Hepcidin, a key regulatorof iron metabolism, is transcriptionally activated by p53. Br J Haematol. 2007; 13(2):253-262.
7. Piperno A, galimberti S, Mariani R, Pelucchi S, Ravasi D, Lombardi C, et al. Modulation of hepcidin production during hypoxia-induced erythropoiesis in humans in vivo: data from HIGHCARE project. Blood. 2011; 117(10):2953-2959
8. Bao B, Chang KC. Carrots pulp chemical composition, color and water-holding capacity as affected by blanching. J Food Sci. 1994; 59(6):1159-1161.
9. Swar MO and Osman AM. Carbaodeim: A natural hematinic blend for treatment of dimorphic anaemia of malnutrition. Sudan J Paediatr. 2014; 14(2):41-48
10. 10. Groff JL, Gropper SS, Hunt SM. Advanced Nutrition and Human Metabolism. West Publishing Company. New York 1995.
11. Christofides A, Schauer C, Zlotkin SH. Iron deficiency anaemia among children: Addressing a global public health problem within a Canadian context. Paediatr Child Health. 2005; 10(10): 597–601.
12. Ahmed ME, Hamid HBB, Babikir HE, Eldor AAA. Effects of Grewia tenax (Guddaim) as a natural food on J the hemoglobin level and growth among displaced children of Darfur State, Western Sudan. Journal of Medicine and Medical Sciences 2012; 3:729-733.
13. Janus J, Moerschel SK. Evaluation of Anaemia in Children. Am Fam Physician. 2010 Jun 15; 81(12):1462-1471.
14. Mast AE, Blinder MA, Lu Q, Flax S, Dietzen DJ. Clinical utility of the reticulocyte haemoglobin content in the diagnosis of iron deficiency. Blood. 2002; 99(4):1489–1491.
15. Parodi E, Giraudo MT, Davitto M, Ansaldi G, Mondino A, Garbarini L, et al. Reticulocyte parameters: markers of early response to oral treatment in children with severe iron-deficiency anaemia. J Pediatr Hematol Oncol. 2012; 34(6):e249-e252.
16. Naigamwalla DZ, Webb JA, Giger U. Iron deficiency anaemia. Can Vet J. 2012; 53(3): 250–256.
17. Harvey JW. Iron metabolism and its disorders. In: Kaneko JJ, Harvey JW, Bruss ML, editors. Clinical Biochemistry of Domestic Animals. 6th ed. Burlington, Massachusetts: Elsevier 2008; 259–285

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