



## Vitamin A Contents Per Serving of Eleven Foods Commonly Consumed in Jordan

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**Abstract:** Vegetable consumption plays an essential role in maintaining health. In this study an evaluation of 11 raw foods (Mallow, Okra, green beans, dry beans, faba beans, Chickpea, lentil, carrot, tomato, eggplant and zucchini) was carried out to find out their content of vitamin A in mcg Retinol Activity Equivalents (RAE) per serving (100g) and to find out their contribution to the Dietary Reference Intakes (DRI): Estimated Average Requirements (EAR) of vitamin A by consuming one serving of food for children, adult females and males. Foods with the greatest content of provitamin-A, in decreasing order were carrot, mallow, green beans, okra, zucchini, faba bean tomato, dry bean, eggplant, lentil and chickpea. The percentage of  $\beta$ -carotene from total carotenoids found to vary from 1.3% for lentil to 54% for carrot. The vitamin A content per serving found to range between 0.64  $\mu$ g (RAE) for lentil to 592.1  $\mu$ g (RAE) for carrot. Consumption of just one serving of mallow will cover about 11.2% of the daily requirement of vitamin A for children aged 4-8 y and about 3.5% for lactating women and about 5.7% during pregnancy. Vitamin A content of one serving of Green beans, okra and zucchini will cover 3.0%, 2.6% and 2.0% of the daily requirements for males and 3.8%, 3.2% and 2.4% for females, respectively, while consumption of one serving of dry beans, faba bean, chickpea, lentil, tomato and eggplant will cover only less than 2% of requirement for males and females. In conclusion, these results agree with those reported in the literature. Although, these foods are considered to be poor sources of the vitamin, they can provide appreciable amounts of vitamin A that is essential nutrient important to human health.

**Key words :** Provitamin A, Foods, Vitamin A,  $\beta$ -carotene, DRI, Jordan.

### Introduction

Deficiency of vitamin A in diet has always been identified as a significant nutrition problem<sup>1</sup>. The prevalence of vitamin A deficiency among children in developing countries, is estimated to be 30%, about 163 million cases<sup>2</sup>, and pregnant and lactating women are tended to be affected as well, in some instances at alarmingly high levels<sup>3,4</sup>.

Carotenoids are a class of pigments that many of them occur in foods with plant origin. They are regarded as being antioxidants in biological tissues along with in food systems<sup>5,6</sup>. While about 50 carotenoids could theoretically be vitamin A precursor, vitamin A activity has been measured for just about 15 of them. Definitely the main one with the best provitamin A effect is beta-carotene. Alpha carotene and beta cryptoxanthin might have about half its activity<sup>7</sup>.

Epidemiological studies suggest an inverse association between dietary consumption of plant products rich in carotenoids and vitamin A (retinol), and the incidence of various types of human cancer and other diseases<sup>8,9</sup>. Generally, a wide variety of foods containing either preformed or provitamin A are widely available and acceptable to nearly everyone in most countries<sup>10,11,12</sup>. A listing of the most useful ones in many settings is provided by Rodriguez Amaya<sup>13</sup>.

The aim of this study is to find out the content of vitamin A per serving of 11 raw foods commonly consumed worldwide including Jordan, then determining the contribution of 1 serving consumed of each food item by adult males and females of the Dietary Reference Intakes (DRI) as % of the DRI.

## Materials and Methods

The eleven foods included in this study, were previously analyzed within our previous work for their carotenoid composition and content by using - high performance liquid chromatography (HPLC)<sup>14,15,16,17</sup>. Based on these analyses, we recalculate this content of every food total carotenoids, provitamin A content of carotenoids in  $\mu\text{g}$  and the contribution of vitamin A percentage of DRI by consuming one serving of food for children, adult females and males.

The Vitamin A in mcg Retinol Activity Equivalents (RAE) was obtained for each serving by converted the amounts present in 1  $\mu\text{g}$  of every food into one serving. In this work the serving size was determined based on the USDA food composition tables<sup>18</sup>, and is considered to be 100 g.

Retinol Equivalents were estimated using the conversion factor according to the US Institute of Medicine : Each  $\mu\text{g}$  RAE corresponds to 1 $\mu\text{g}$  retinol, 12  $\mu\text{g}$  of "dietary" beta-carotene, or 24  $\mu\text{g}$  of the other dietary provitamin-A carotenoids<sup>19</sup>.

The percent Dietary Reference Intakes (DRIs): Estimated Average Requirements (EAR) for Groups of females and males of every content of the various food were calculated as follows: % DRI = vitamin A content\*100/EAR.

As an example, the EAR for adult males  $\geq 19$  y for vitamin A is 625  $\mu\text{g}/\text{d}$ . Consuming one serving of Mallow will cover 4.9% of the daily vitamin A requirement.

## Results

Common English, Scientific and local names of foods included in this study were present in (Table 1). The mean contents of vitamin A in mcg Retinol Activity Equivalents (RAE) of raw vegetables are given in (Table 2), along with  $\beta$ -Carotene and vitamin A contents from the USDA database<sup>18</sup> to enable comparisons of values obtained in the present study. Analysis of the foods showed that, foods with the best content of provitamin-A, in decreasing order were carrot, mallow, green beans, okra, zucchini, faba bean tomato, dry bean, eggplant, lentil and Chickpea. The percentage of  $\beta$ -carotene from total carotenoids was 54.0, 26.0 and 21.9 in carrot, dry beans and mallow, respectively.

**Table 1. Common English, Scientific and Local names of analyzed foods**

No of Food	English Name	Scientific Name	Local Name
1	Mallow	<i>Corchorus olitorius</i>	Molokheya
2	Okra	<i>Abelmoschus esculentus</i>	Bamia
3	Green beans	<i>Phaseolus coccineus</i>	Fasolia Kadra
4	Dry beans	<i>Phaseolus vulgaris</i>	Fasolia Jaffeh
5	Faba bean	<i>Vicia faba</i>	Foul
6	Chickpea	<i>Cicer arietinum</i> L.	Hummus
7	Lentil	<i>Lens esculenta</i>	Adas
8	Carrot	<i>Daucus carota</i> L.	Jazar
9	Tomato	<i>Lycopersicum esculentus</i>	Bandora
10	Eggplant	<i>Solanum melongena</i>	Bazinjan
11	Zucchini	<i>Cucurbita pepo</i>	Kussa

**Table 2. Vitamin A in meg Retinol Activity Equivalent (RAE) contents, edible portion measure per serving (Cup,100g raw ), of commonly consumed foods**

No of Food	Food	Provitamin-A Content of Carotenoids, µg (RAE)	% of β-carotene from total carotenoids	USDA database contents *, µg	
				β-Carotene Per measure *	Vitamin ,RAE Per measure *
1	Mallow	30.9	21.9	-	-
2	Okra	16.1	7.6	416	36
3	Green beans	19.0	11.7	379	35
4	Dry beans	3.3	26.0	6	1
5	Faba bean	7.4	2.9	196	17
6	Chickpea	0.64	1.4	-	3
7	Lentil	1.31	1.3	23	2
8	Carrot	592.1	54.0	8285	835
9	Tomato	6.6	3.6	449	42
10	Eggplant	1.5	3.8	14	1
11	Zucchini	12.2	4.3	120	10

<sup>a</sup> Values represent mean of 3 measurements

\*USDA, 2013. National Nutrient Database for Standard Reference Release 27 Software v.2.0b <http://www.ars.usda.gov/Services/docs.htm?docid=8964>

**Table 3. Percentage contribution to vitamin A requirement by consuming 1 serving of food for children, adult females and males.\***

Life Stage Group	DRI require ment (EAR)* (µg/d)	Percentage contribution to vitamin A requirement										
		No of Food										
		1	2	3	4	5	6	7	8	9	10	11
<b>Children 4-8 y</b>	275	11.2	5.9	6.9	1.2	2.7	0.23	0.48	215.3	2.4	0.55	4.4
<b>Males 9-13 y</b>	445	6.9	3.6	4.3	0.74	1.7	0.14	0.29	133.1	1.5	0.34	2.7
<b>14-18 y</b>	630	4.9	2.6	3.0	0.52	1.2	0.1	0.21	94.0	1.1	0.24	1.9
<b>≥19 y</b>	625	4.9	2.6	3.0	0.53	1.2	0.1	0.21	94.7	1.1	0.24	2.0
<b>Females 9-13 y</b>	420	7.4	3.8	4.5	0.79	1.8	0.15	0.31	141.0	1.6	0.36	2.9
<b>14-18 y</b>	485	6.4	3.3	3.9	0.68	1.5	0.13	0.27	122.1	1.4	0.31	2.5
<b>≥19 y</b>	500	6.0	3.2	3.8	0.66	1.5	0.13	0.26	118.4	1.3	0.3	2.4
<b>Pregnancy 14-18 y</b>	530	5.8	3.0	3.6	0.62	1.4	0.12	0.25	111.7	1.3	0.28	2.3
<b>19-50 y</b>	550	5.6	2.9	3.5	0.6	1.3	0.12	0.24	107.7	1.2	0.27	2.2
<b>Lactation 14-18 y</b>	885	3.5	1.9	2.2	0.37	0.84	0.07	0.15	66.9	0.75	0.17	1.4
<b>19-50 y</b>	900	3.4	1.8	2.1	0.37	0.82	0.07	0.15	65.8	0.73	0.17	1.4

\*(DRIs): Dietary Reference Intake ; (EAR) :Estimated Average Requirements for Groups . 1: mallow, 2: okra , 3: green beans, 4: dry beans, 5: faba beans, 6: chickpea,7: lentil, 8: carrot, 9: tomato , 10: eggplant and 11: zucchini

Percentage contribution to vitamin A requirement by consuming one serving of each food is presented in (Table 3). For example, consumption of just one serving of mallow will cover 11.2% of the daily requirement of vitamin A for children aged 4-8 y and about 3.5% for lactating women and about 5.7% during pregnancy. Vitamin A content of one serving of green beans, okra and zucchini cover 3.0%, 2.6% and 2.0% of the daily requirements for males and 3.8%, 3.2% and 2.4% for females, respectively, while consumption of 1 serving of dry beans, faba bean, chickpea, lentil, tomato and eggplant will cover only less than 2% of requirement for women and men.

## Discussion

Carotenoids are largely widespread in many fruit and vegetable foods. Beta-carotene is widely studied for both its abundance in fruits and vegetables and its pro-vitamin A activity<sup>20</sup>. Several studies revealed that an abundance of carotenoids in the diet may be protective against many diseases, reducing the risk of cardiovascular disease and some forms of cancer<sup>20,21</sup>.

It is known that carotenoids are not as well absorbed than retinol and once absorbed should be transformed into retinol in the body. The conversion factor utilized by most researchers in estimating the retinol equivalency of carotenoids was 6:1 until 2000, once the US Institute of Medicine<sup>22</sup>, changed its estimate to 12:1. An increased value might be more accurate for the diets of most low-income people<sup>23</sup>.

Using intrinsically labeled beta carotene, the conversion factor found for spinach was about 21 and for carrots was around 15<sup>24</sup>. Fruits and vegetables have assumed the status of 'functional' foods, effective at providing additional health advantages, such as meeting basic nutritional requirements, in addition to prevention or delaying onset of chronic diseases. Appropriate intake of many fruits and vegetables ensures sufficient way to obtain nutrients and phytochemicals such as for carotenoids<sup>25</sup>. It is thought that low intake of fruit and vegetable is among the most effective ten risk factors resulting in the world mortality<sup>26</sup>. Legumes such as for example beans, lentils and chickpea are believed as a nutrient dense foods and really are a good source of several nutrients such as for instance dietary fibers, minerals, vitamins and phytochemicals including carotenoids<sup>27,28</sup>.

Vitamin A deficiency disease (VAD) can occur in individuals of any age. However, it is a serious problem for children under 6 years old. Women of reproductive age are thought also to be susceptible to VAD during pregnancy and lactation<sup>29</sup>. (VAD) is associated with several health disorders including night blindness, an irreversible form of blindness called xerophthalmia, growth retardation, depressed immune response, and increased childhood mortality<sup>30,31</sup>. Despite several supplementation and food fortification programs, VAD affects millions of children and pregnant women and results in more than 4 million children suffering xerophthalmia and about 800,000 deaths annually, mostly in developing countries<sup>31,32,33</sup>.

Previous studies indicate that in developed countries no more than 35% of dietary vitamin A arises from plant sources<sup>34</sup>, whereas preformed vitamin A derived from animal products provides more than 70% daily vitamin A intake<sup>35</sup>. In contrast, in developing countries, plants typically provides over 80% of vitamin A<sup>36,37</sup>, reaching 95% in Bangladesh<sup>38</sup> and over 1/3 of that is from indigenous varieties<sup>4,39</sup>.

Children with low vitamin A intake tend to come from families with low socioeconomic status<sup>40</sup>. It is often assumed that children dislike eating dark green leafy vegetables. However, they accept it once they have tasted it numerous times. One study in Bangladesh found that 89% of children 6 months to 3 yr old likes them<sup>41</sup>.

## Conclusion

It is concluded that, the results obtained from the analyzed foods in this study agree with those reported in the literature. Although, these foods are considered to be poor sources of the vitamin, they can provide appreciable amounts of vitamin A that is essential nutrient important to human health.

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