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ORIGINAL ARTICLE

Comparative study of fatty-acid composition of table eggs from the Jeddah food market and effect of value addition in omega-3 bio-fortified eggs

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Docosahexaenoic acid (DHA)

Abstract Health consciousness has increased the desire of people around the world to consume functional foods. Omega-3 essential fatty acids are one among these beneficial and important health supplements without which a general predisposition to degenerative and stress related disorders can occur. Saudi Arabia has shown an alarming increase in obesity (Al-Nozha et al., 2005), diabetes (Alqurashi et al., 2011), and cardiovascular disease (Al-Nozha et al., 2004) in the last few decades mainly due to nutritional transitions and lifestyle alterations (Amuna and Zotor, 2008). Lack of nutrient dense foods and the prevailing food related disorder of obesity (Popkin, 2001; Prentice, 2014) especially render egg as a choice food to be value-added for attaining nutritional security in Saudi Arabia and in effect reverse the increasing incidences of lifestyle diseases. Nutritional intervention through a commonly consumed food product would be an important step in improving the health of the people, and reducing health care costs. As eggs are a frequently consumed food item in Saudi Arabia, enriching them with omega-3 fatty acids would be an excellent way to alleviate the existing problems. A significant deposition of omega-3 fatty acids in the eggs was observed when the diet of hens was supplemented with omega-3 fatty acids from either flaxseed or fish oil source. Inadequacy of omega-3 fatty acids could thus be rectified by producing omega-3 enriched eggs from

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hens supplemented with flaxseed or fish oil source, and thus contribute toward better health choice of the consumer.

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1. Introduction

Lifestyle diseases arising from nutritional deficiencies are taking alarming proportions in Saudi Arabia (Al-Nozha et al., 2005; Alqurashi et al., 2011; Al-Nozha et al., 2004; Popkin, 2001; Prentice, 2014). Growing trend in the consumption of junk food is leading to rapid onset of lifestyle disorders in Saudi Arabia (Amuna and Zotor, 2008). An increased consumption of omega-6 type of fats as in the diets in the western countries (Simopoulos, 2002; Massiera et al., 2010) is causing an imbalance in the recommended omega-6:omega-3 (n-6: n-3) fatty acid ratio (Ferrier et al., 1995). The American Heart Association (AHA) guideline recommends food practices that have a positive association with good health and do not disallow or limit egg consumption (Kritchevsky, 2004). Health professionals recommend a lowering of high cholesterol and increasing consumption of polyunsaturated fatty acids for better health outcomes.

Past four decades have seen drastic changes in the socio-economic conditions in Saudi Arabia. The beneficial effects of these changes have, however, unfortunately been paralleled by negative influences on the nutrition, and lifestyle of the Saudi population, resulting in adverse health conditions. A dietary shift from the high fiber and low fat diet of the past to the unhealthy diets in today's times has resulted in increased risk for cardiovascular problems, diabetes, and obesity (Musaiger, 2002). According to the Bahrain Medical Bulletin (Madani, 2000), strategies to prevent obesity in Saudi Arabia should include encouragement of outdoor physical exercise, decreased consumption of fatty foods, and lifestyle changes. Saudi Arabia has a high percentage of adults suffering from high cholesterol (Baba, 2000). High energy foods rich in fats and sugars (Musaiger, 1994, 2002) have increased the benchmark of total energy consumption per capita to 3000 kcal. Saudi recommendations allow energy intakes of 2100 kcal per capita (Khan and Al-Kanhal, 1998). Economic affluence has resulted in sedentary habits leading to fat consumption beyond the 30% of the allowed energy intake recommended for sedentary individuals (FAO, 1994). Therefore, there is an increased need for functional foods providing health benefits to the general population. Furthermore, increased health awareness has created recognition and consumer demand for nutritional products enhancing health.

Omega-3 fatty acids are one of the most sought after components in the functional food sector. It has been observed (Ramirez et al., 2001) that egg lipids are efficiently absorbed in the body, thereby increasing the bioavailability of docosa hexaenoic acid (DHA) and also increasing levels of high density lipoproteins (HDL). This makes the omega-3 enriched egg a potentially health benefitting functional food (Lewis et al., 2000; Gil et al., 2003; Hoffman et al., 2004; Yalcin and Unal, 2010). Eggs have been well accepted as a safe and nutritious food for all ages. Recommendations from the Canadian government require 0.5% of total energy intake as omega-3 fatty acid based on the fact that North American diets are low in this nutrient (Health Canada, 1990). This has prompted the egg industry to step in to bring back omega-3 fatty acids into the food chain. Omega-3 enriched eggs would, therefore, serve as an ideal food to increase the amount of omega-3 fatty acids in the Saudi Arabian diet.

Egg is a balanced and nutrient rich inexpensive food containing high bioavailable protein, making it a reference food for protein quality (Herron and Fernandez, 2004). The Saudi poultry industry centers around two major products i.e. table eggs and broiler meat. Production of eggs has increased from 145 to 191 thousand tons from the year 2005 to 2009. Food Agriculture Organization figures of import for the major Arab countries during the years 2000–2005 showed a 66% increase, ranging from 465,000 to 770,000 tons, in a short period of 5 years. Production of table eggs has been estimated to increase by around 50% owing to population boom by around 25% and enhancement in per capita consumption of eggs (Freiji, 2008). The awareness that saturated fats and cholesterol are bad for health has turned away many consumers from meat and eggs and this is the main reason that is limiting popularization of poultry products in spite of immense nutritive values.

One of the most intriguing developments related to the food industry and public health in future may come from a higher demand of the essential omega-3 fatty acids, such as alpha-linolenic acid (ALA) eicosapentaenoic acid (EPA) and DHA in the food products. Traditionally, most of the omega-3 fatty acids in the diet have come from fish and fish oil but such foods are not eaten in enough quantities or the right kind of omega-3 rich fish are not consumed. In an effort to meet the growing demands of the health conscious consumers, egg as a nutrient dense food has been tapped (Drewnowski, 2005). The egg could serve as an unadulterated rich source of omega-3 fatty acid. Eggs contain a high density of nutrients and are a good source of proteins, vitamins, and lipids of high quality such as phospholipids and polyunsaturated fatty acids PUFAs (Meluzzi et al., 2000; Ruxton, 2010). In olden days, the country eggs contained a fairly good amount of omega-3 fatty acids and were healthy and safe for consumption. The present day poultry eggs are depleted of this essential nutrient because of intensive and industrialized poultry farming. Moreover, the health conscious consumer is dissuaded from consuming eggs because of its high fat content (Hu et al., 1999; Qureshi et al., 2007; Yaffee, 1991).

The fatty acid composition of yolk lipids can be altered depending upon the diet of the layer birds (Ahmed, 2009; Singh and Sachan, 2010). These omega-3 enriched eggs contain almost four fold DHA than the normal amount in commercially sold eggs (Lewis et al., 2000). Eggs produced from hens receiving conventional feeds tend to be relatively high in omega-6 fatty acids but poultry feed manipulation can be used successfully to either increase the amount of DHA directly using fish oil or indirectly by increasing the levels of precursor

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