

# Natural Enrichment of Consumption Eggs by Omega-3: A Micro-Study of the Market in Morocco

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## **Abstract**

Omega-3 has an important role in the human body. This and other lipids should be contained in the diet and cannot be synthesized by the body. Several developed countries have successfully used an approach to naturally enrich eggs with omega-3 and place this product on the market. This method consists of subjecting laying hens to a diet rich in omega-3. To our knowledge, this approach has not yet been included in the egg marketing chain in Morocco. We conducted market research on omega-3 enriched eggs to obtain information from customers about their needs, their motivation to buy this product, and their preferences. Large supermarkets in six major Moroccan cities were chosen. The number of customers surveyed was set at 360 customers. The results show that 42.5% of these customers already know about omega-3, and 83% of them are aware of the interest in this nutrient. On the other hand, 38% of respondents suffer from a disease or different diseases: 22% are diabetic, 16% suffer from hypercholesterolemia, 16% are hypertensive, and 10% have other diseases. After explaining to them the benefits of omega-3, about 80% of respondents believe that the product is interesting, of which 74% are ready to buy it at a base price of 2 dirhams. This study demonstrates that the marketing of this enriched egg could have a positive impact on

the local economy, help to correct dietary deficiencies, and prevent certain diseases.

**Keywords:** Cholesterol, Consumer, Distribution, Egg product, Fat, Hypertension, Nutrition, Survey

## 1. Introduction

Lipids constitute the fat of the human body. They play, at the same time, an energetic, structural, nutritional, and metabolic role (Vors, 2012). The quality of lipids present in our diet is essential to establish good nutritional balance. Several studies have demonstrated the impact of dietary lipids on human health, especially omega-3 fatty acids ( $\omega$ 3) (Bourre, 2005-a). This category of lipid is unable to synthesize it itself; therefore it must be introduced to the body through dietary intake. On the one hand, the regular consumption of polyunsaturated fatty acids from the omega-3 family has beneficial cardiovascular effects, such as lowering blood pressure and reducing the amount of triglycerides in the blood (Cazzola et al., 2007). Omega-3s are also considered as anti-inflammatories because they have the capacity to reduce the severity of certain inflammatory conditions (Libby, 2002). Moreover, it has been reported that omega-3 promotes brain development, as well as concentration and amelioration of learning abilities in children, because it forms most of the fatty acids in the brain (Anderson et al. 1990).

However, the daily consumption of foods rich in omega-3 is very low compared to the intake recommended (AFSSA, 2003), which is 2 g/day of linolenic acid for adults. Egg is one of the most consumed foods (Nau et al., 2010) and it contains significant amounts of saturated fatty acids and a modest amount of polyunsaturated fatty acids. Therefore, the lipid profile of the egg can be changed by altering the type of diet fed to laying hens, and using a source of omega-3 will lead to the natural enrichment of eggs by this nutrient (Bourre, 2005-b). In this way, scientists have expressed an interest in certain seeds rich in  $\alpha$ -linolenic acid. This can be introduced in animal feed in order to provide animal products with better nutritional quality (Pinotti et al., 2014). Omega-3 enrichment is usually achieved by subjecting laying hens to a diet based on several sources: fishmeal, *Camelina sativa*, linseed (*Linum usitatissimum*), and *Euphorbia heterophylla* seeds. Studies have shown that this natural enrichment of foods significantly increases the concentration of omega-3 in eggs (Cherian et al., 2009; Combe & Féart, 2004; Kouakou et al., 2015). However, these reviews have shown that the concentrations of the feed ratios of the hens must respect thresholds in order to prevent the alteration of the organoleptic properties of the eggs and to avoid an increase in total fats and cholesterol level in the eggs.

According to a Moroccan study on household consumption, carried out by the Office of the High Commissioner for Planning (2001), the average consumption of eggs per person is 65 units per year. The annual quantities of eggs consumed per citizen vary from 20 to 140 units. In recent years, several countries, including the United States, Canada, Japan, and countries within the European Union, have managed to use the omega-3 egg enrichment approach and to market this product with competitive prices. In Morocco, to our knowledge, this approach has not been included in the egg marketing and distribution chain. The objective of this article is to present a market and feasibility micro-study that was conducted in Morocco on

the natural enrichment of omega-3 consumption eggs. This research aimed to interview egg consumers in different regions of the Kingdom to understand their expectations, needs, and motivations for the purchase of naturally enriched omega-3 eggs.

## **2. Material and Methods**

The methodological approach followed in this study consisted of a structured and formal survey. This was based on a closed questionnaire that was distributed to consumers. Three parameters were set (place of study, target population, and number of people to be interviewed), to which we applied reasoned sampling. Thus, six cities (Oujda, Fes, Rabat, Salé Casablanca, and Marrakech) were initially chosen where there are large supermarkets. Then, the investigation targeted people according to their intellectual, economic, and sociocultural levels. Finally, a random sample was taken of 60 customers per each city.

The elaboration of the questionnaire is essential for the collection of information from participants (see Appendix 1). The questionnaire contained questions that were visible, legible, and above all understandable. The questionnaire was organized into three sections: (i) personal issues (gender, age, grade level); (ii) nutritional and health issues, to analyze the rate of daily consumption of omega-3 participants, and to detect the proportion of the presence of diseases related to the deficiency of this nutrient; and (iii) economic issues, to get an idea of the motivation and opportunity for people to buy naturally enriched omega-3 eggs.

This study was conducted from April 17 until May 12, 2017. For each city, the surveys were conducted at the exits of the supermarkets to interview outgoing customers. In order to intercept the maximum number of clients, the interviews were carried out in the evening, between 5:00 and 9:00 pm. People were randomly selected and allowed to accept or refuse the investigation. Before starting the interview, respondents received an explanation about the purpose of the study as well as the content of the questionnaire. The interview took between 10 and 15 minutes.

This study consisted primarily of asking questions about omega-3 (definition, sources, daily intake, etc.). Then, explanations of enriched omega-3 eggs and the production procedure were offered, and respondents were asked about their interest compared to standard eggs. Once this initial investigation was completed, the questionnaires were filled in, retaining anonymity for the respondent and allowed them to not answer any questions that were uncomfortable for them. The questionnaires were then organized, standardized and entered into the database. The data were processed, analyzed, and presented in diagrams/graphs, using Microsoft Excel.

## **3. Results**

The sample or study population (360 clients) comprised 63% women and 37% men, the most dominant age group of which was older than 30 years (85%) and the most frequent level of education was university education (63%). The results show that omega-3 was known by 42.5% of respondents (127 clients), of which 83% were aware of the interest in this nutrient. Table 1 shows the distribution of 127 clients who already knew about omega-3.

Table 1. Distribution by city of the 127 customers who know the omega-3.

	Site of the study (Moroccan cities)					
	Rabat	Salé	Casablanca	Marrakech	Fes	Oujda
% of the population	28,3	22,8	22,1	6,3	12,6	7,9

In addition, 42%, 34%, and 24% of the study population consumed, respectively, 3–6 eggs/week, more than 6 eggs/week, and fewer than 3 eggs/week. Regarding the most consumed part of the egg, results show that 65% of people consumed whole eggs, 26% preferred egg white, while only 9% consumed the egg yolk only.

In regard to the richest omega-3 foods available on the national market, flaxseed and fish, the study shows that they were consumed daily by 13% of respondents and once or twice a week by 60% of them. Few people did not consume them at all for health reasons (14%), and 13% consumed these foods occasionally (Figure 1).

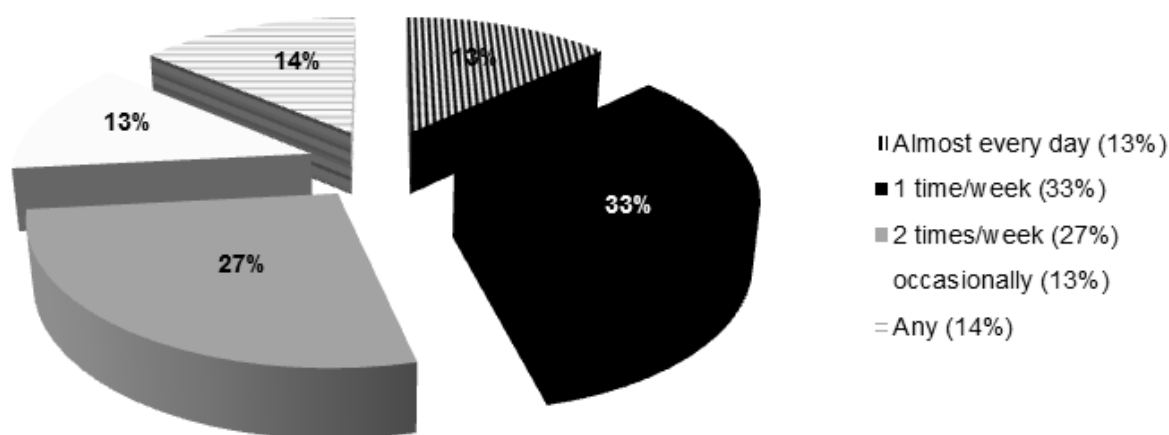


Figure 1. Fish consumption rate of 360 surveyed customers.

For flaxseed, only 8% of respondents reported consuming it every day by incorporating flaxseed into various culinary preparations (bread, cakes, etc.). Half of these people consumed flaxseed occasionally. On the other hand, a large proportion of the population (42%) did not consume these seeds either through ignorance or negligence (Figure 2).

A deficiency of omega-3 can promote the onset of several diseases in the population. Conversely, a sufficient intake of this nutrient can help to eliminate several diseases, especially cardiovascular diseases (Leaf, 2009). Thus it was important to ask questions about these issues in order to detect the need to enrich omega-3 meals. From this perspective, the results show that about 38% of those surveyed suffer from diseases: 22% are diabetic, 16% have hypercholesterolemia, 16% have arterial hypertension, and 10% have diseases with other causative agents (Figure 3).

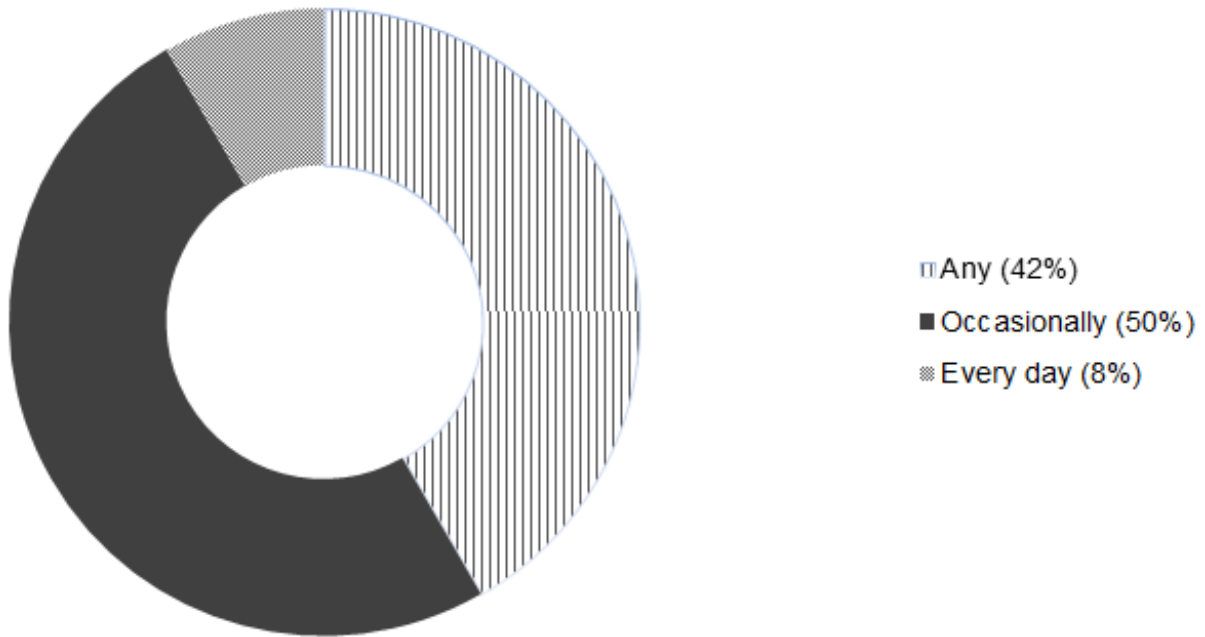


Figure 2. Flaxseed consumption rate of the 360 clients surveyed.

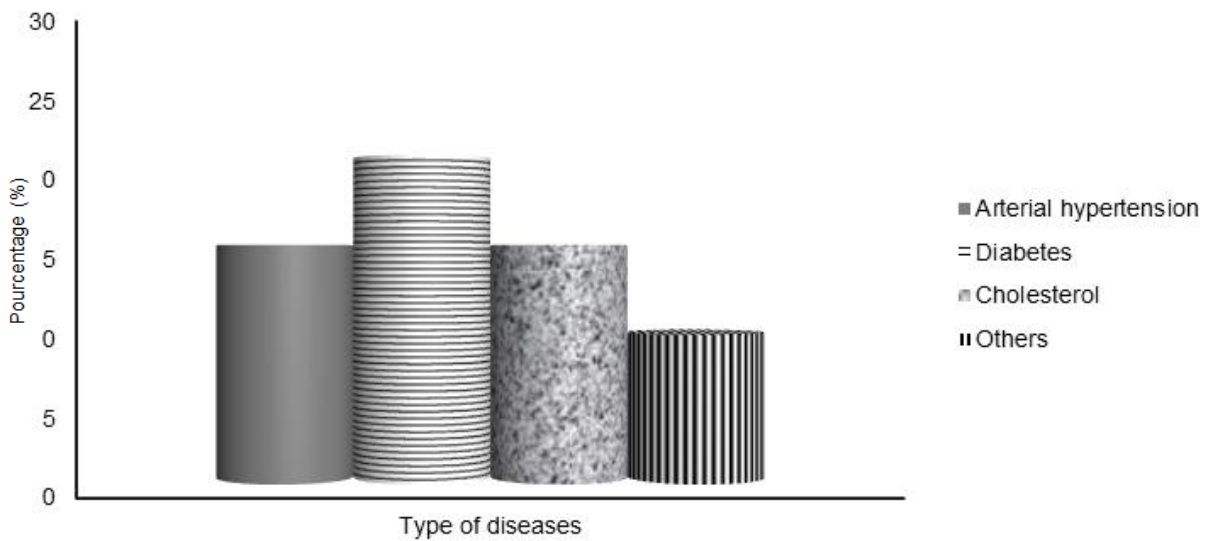


Figure 3. Rates of some diseases present among the 360 surveyed clients.

In terms of the economic point of view and in relation to the purchasing power of Moroccan citizens, the results of this study show that nearly 80% of customers considered eggs enriched with omega-3 to be interesting (Figure 4), and 74% were potentially willing to buy the product at a base price of 2 dirhams (DH). However, this price remained controversial and differently appreciated by people: it was regarded as reasonable by 55% of respondents, expensive by 29%, and unaffordable by 16% (Table 2).

Is the product important ?

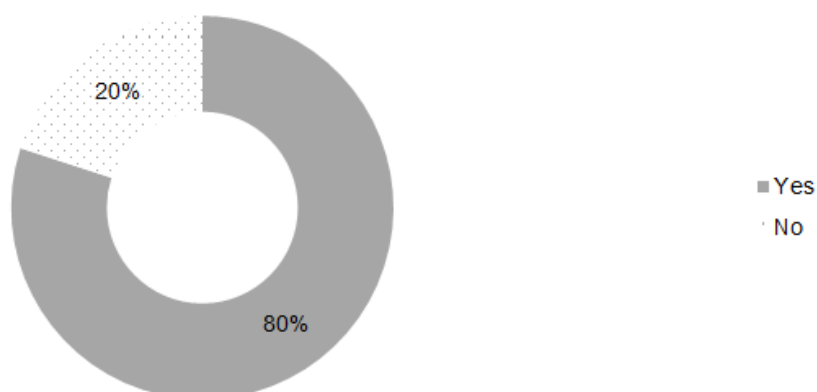


Figure 4. Importance of naturally enriched omega-3 eggs in the study population, after having explained the interest of this nutrient to 360 clients.

Table 2. Distribution of 287 customers according to their ability to purchase the omega-3 enriched egg at a base price of 2 DH \* and their opinions regarding this price.

	Possibility of buying the product at basic price		Base price notice		
	Yes	No	Reasonable	Expensive	Too expensive
% of the population	74	26	55	29	16

\*DH= Moroccan Dirham (MAD).

#### 4. Discussion

The results show a high frequency of egg consumption by a sample of the population participating in this study. This was due to several factors: low price, multiple culinary uses, and quick and easy preparation. Nevertheless, data related to the consumption of the richest omega-3 foods available in Morocco are alarming: on a daily basis, only 8% of respondents consumed flaxseed and 13% consumed fish. This same concern has already been expressed by Asif (2001) for flaxseed and by Kris-Etherton et al. (2002) for fish.

Omega-3 should be consumed by people every day, especially because most of the food consumed daily (vegetables, fruits, bread, legumes, etc.) contains little natural omega-3 (Dieticians of Canada, 2015). Also, we suspect that the majority of our respondents suffer from an omega-3 deficiency. Hence, there is a need for daily omega-3 supplementation in order to fill this gap (Bowen et al., 2016; Simopoulos, 2016). This supplementation should be among the priorities of public authorities, and this study confirms the presence of several pathologies, at notable proportions, among the interviewees (high blood pressure: 16%; diabetes: 22%; hypercholesterolemia: 16%). Moreover, greater consumption of omega-3 would prevent massive cardiovascular disease (Mozaffrian & Wu, 2011; Weitz et al., 2010). Unfortunately, this nutrient was unknown among nearly 60% of our interviewees. Only



42.5% had already heard of omega-3, and these participants had no knowledge of what it is (vitamin, protein, lipid, etc.) or the reason for interest in this nutrient. However, after people learned about the nutrient, as well as about the interest shown in it and the method of its production, about 80% declared themselves to be interested in the product and accepted a price of 2 DH. This price takes into account all the expenses related to the production of the egg, as well as the price of the national market. In addition, 74% of respondents would be predisposed to purchase omega-3 enriched eggs once available on the market.

The results of this preliminary study suggest that among respondents, the usefulness of eggs was regarded as solely a type of food. However, eggs and other types of food can also serve as a vector for economic recovery as well as a means of correcting dietary deficiencies and preventing certain health problems. The production and marketing of these new enriched products, also called “functional” products, must be based on scientific studies that take into consideration the entire industry with all its production links and value chains. Consequently, the establishment of a regulatory framework is mandatory. This framework must be accompanied by international standards of quality and traceability. Eggs naturally enriched with omega-3 should be part of this framework. We believe that this is a project that will generate great interest and acceptance among the public in Morocco. Such a project would be able to help overcome several health problems within the overall population; other virtues of this scenario are that enriched eggs could be available at an affordable price and especially that they represent a natural product. However, more in-depth, integrated, and repeated studies will be needed to fully investigate the feasibility of producing and marketing omega-3-enriched eggs in Morocco.

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## **Glossary**

**Diabetic:** a physiological disease can affect the body and where the production of the insulin (hormone) is reduced, resulting in high concentration of glucose in the blood.

**Dietary Deficiencies:** an insufficient quantity of essential nutrients in the diet such as minerals and vitamins resulting in disequilibrium of nutrition of the body.

**Hypercholesterolemia:** is the presence of excessive amount of cholesterol in the blood.

**Hypertensive:** called also high blood pressure (HBP). This phenomenon is caused when the blood pressure in the arteries is obstinately raised.

**Naturally Enrich Eggs with Omega-3:** eggs of conventional chickens where their feed is supplemented with an omega-3 source like flaxseeds, linseeds, etc. The level of omega3 fatty acid is usually higher in this naturally enriched eggs compared to conventional eggs.

**Nutritional Balance:** this is reached when the body consumes the accurate amount of calories, macronutrients and micronutrients from diet. This balance requests healthy food from various sources (vegetables, meat, milk, fish, etc.). Others definitions demand the exempting of diet from additives, pesticides and others chemical and industrial compounds.

**Omega-3 Fatty Acids:** a class of essential fatty acids, polyunsaturated, found in fish, acts to lower cholesterol and triglyceride levels in the blood and reduced inflammatory reactions.

**Random Sample:** a method in which all members of a population have an equal and

independent chance of being selected. This approach is requested and usually used in scientific research for designing the experimental plans.

## Appendix

### Appendix 1. Questionnaire presented during the study

*This questionnaire is conducted as part of a market study that we are conducting on the introduction of a new product "Eggs enriched with Omega 3".*

*This questionnaire is strictly anonymous, which means that it contains no nominative information identifying the person who answers to this this. We ask you to fill it carefully, the quality of the information collected is very important for the investigation that we are conducting.*

*If you find some embarrassing or intrusive questions, feel free not to answer them.*

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#### **Personal information:**

- 15) You are :       Women       Men  
16) What age range do you belong to?  
 18-30 year       30-45 year       > 50 year  
17) Level of education :  
 Illiterate       Primary       Secondary       University
- 

#### **Food, nutrition and sanitary information:**

- 18) Do you eat eggs?       Yes       No  
If yes, you consume them:       Full       White only       Yellow only  
19) The frequency of your egg consumption:  
 < 3 eggs /week       3-6 eggs /week       > 6 eggs /week  
20) Do you have health problems?       Yes       No  
If yes, Which one?       High blood pressure       Diabetes       Cholesterol       Other  
21) Do you know, what is omega-3?       Yes       No  
If yes:  
22) Do you know what the interest of omega-3?       Yes       No  
23) You know where to find it?       Yes       No  
If yes, what source of omega-3 you consume?  
.....  
.....  
24) What is your frequency of consumption of:  
Fish:       Any       Almost every day       Once/week  
             Twice/week       Occasionally  
Linseed:       Any       Everyday       Occasionally
- 

#### **Economic Information:**

- 25) The enriched egg, you've already heard?       Yes       No  
26) Do you find the new product interesting?       Yes       No  
27) Are you ready to buy it at a price of 2 DH?       Yes       No  
28) How do you find the price?       Reasonable       Expensive       Too expensive
-

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