



The quality of deep-frozen octopus in the Portuguese retail market: Results from a case study of abusive water addition practices



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ABSTRACT

Octopus spp. are among the most important cephalopod traded. However, consumers frequently complain of excessive reduction of weight/volume, after cooking. A case study in the Portuguese market was held with deep-frozen octopus, being added water and cooking losses evaluated, as well as product's biochemical and microbiological quality. Negative deviations (1.3%–7.7%) to the declared weight were detected in 28% of the products. These shown to be good sources of K, Mg, Cu and Zn and contaminants (Cd, Hg and Pb) were lower than limits. Microbiological quality was generally good though coliform, *E. coli*, molds and yeasts detected indicate poor hygienic conditions in a number of production facilities. Cephalopod species determined were in accordance with the label in all samples. Most of the products (92%) presented significantly higher moisture and lower protein contents than unprocessed samples, signaling water soaking. Cooking losses were also higher than in unprocessed samples. Overall un-conformities were accounted in 80% of the samples, mostly because water was added and not labelled (68%), or because citrates listed as ingredients were not detected. Consumers were shown to be at high risk of being defrauded. New regulations and reference criteria for water addition control need to be enforced.

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1. Introduction

Cephalopods of the genus *Octopus* spp. are among the most important commercially octopus species harvested worldwide, being these cephalopods typically marketed fresh, dried salted and frozen (Barbosa & Vaz-Pires, 2004). This species is highly appreciated mainly in Mediterranean, South American and Asian countries and product demand commands high prices throughout all distribution chain thus, sustaining artisanal as well as industrial fisheries. In Europe, the common octopus (*Octopus vulgaris*) is fished in both the northeast Atlantic and the Mediterranean Sea, mainly by small-scale fishing fleets (Pita, Pereira, Lourenço, Sonderblohm, & Pierce, 2015). In Southern European countries, the common octopus is one of the most important fishery resources in terms of economic value.

Despite product demand, consumers often express discontent

because their expectations are not always corresponded by the purchased product, in particular regarding the excessive reduction of weight/volume, after cooking. It is a common result to have cooked octopus reduced to less than half the purchased weight. Media reports concerning food fraud and in particular seafood counterfeit have increased in the last years and a diversity of incidents to defraud the general public, restaurants, retailers and other seafood business have been reported (Lou, 2015; Mariani et al., 2014). Driven by the high prices attained, octopus is now also under the attention of the media (Coelho, 2013) and based on a general public opinion about the low yield of these products after cooking, suspicions regarding excessive water addition that could be deemed adulteration and result in economic fraud for the buyer, have been raised (Coelho, 2013). Though, no scientific information or technical report has been published up to date on the general quality of the retail products or more specifically on the water uptake by octopus or on the effect of these weight gains on the cooking yield.

In Portugal, cephalopods are an important part of the diet, having these a growing demand, as the products are easy to prepare, have a peculiar texture and flavor and can be cooked in different ways. The

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per capita consumption of octopus represents in Portugal an amount estimated between 2 and 3 kg per year, being the third packed frozen seafood product more consumed, after hake and cod (INE, 2015). The supply is achieved at the expense of domestic production and a strong contribution of imported products.

On account of the importance of octopus in the Portuguese diet and its commercial value, this market was selected as a European model for a case study of the quality of deep-frozen octopus. A comparative test was held with 25 commercial samples of pre-packaged deep-frozen octopus with the objective of evaluating the legal conformity and safety of the products, namely the added water, cooking losses, additives (phosphates and citrates) and labelling as well as the quality of the products, both in terms of biochemical (TVB-N, additives, essential and contaminant elements) and microbiological quality.

2. Material and methods

2.1. Raw material, processing and sampling

2.1.1. Market study

In order to know the universe of brands of deep-frozen octopus

products pre-packaged or sold in bulk available in the retail market, an inquiry was made on site in 40 food shops covering small traditional food shops (12 minimarkets, traditional markets and frozen fish shops) and large food retail chains (28 hyper/supermarkets). The data collection took place during June 2015 in five districts of Continental Portugal (Lisbon, Oporto, Faro, Braga and Guarda) and Madeira and the Azores Islands. The inquiry identified 115 products and 35 brands and the results were subjected to statistical analysis, with determination of frequencies of the brands, by district and retail shop. Based on the geographical representation and frequency of the brand on the market (i.e., number of times a brand is repeated in the different retail shops visited) and the representativeness by distribution channel (large food retail chains, traditional food shops) a sample of 25 brands was subsequently selected (Table 1). In fact, and given the growing importance of own brands of large food retail chains, about half of the sample is composed of these brands (44% large food retail chains brands and 56% manufacturer brands). The sample did not include brands with regional distribution or distribution restricted to the Madeira or the Azores Islands. Sampling also followed a criterion of homogeneity in what concerns the type of product: preference to 1–2 kg whole deep-frozen octopus products of the species *Octopus vulgaris*,

Table 1
Number of packages, net weight, labelled species, capture area, production date and labelled ingredients of 25 deep-frozen octopus products sampled in the Portuguese retail market in October 2015.

Sample	No. of packages	Net weight (kg)	Labelled species	Capture area	Production date	Labelled ingredients
01	4	1.5	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central (FAO 34)	17.08.2015	Octopus, salt
02	4	1.5	<i>Octopus</i> spp.	Atlantic Ocean East-Central	02.09.2015	Octopus, water, salt, E331
03	4	1.3	<i>Octopus vulgaris</i>	Atlantic Ocean North-East (FAO 27), Portuguese waters	19.08.2015	–
04	6	0.8	<i>Octopus mimus</i>	Pacific Ocean South-East	25.04.2015	–
05	10	0.5	<i>Octopus cyanea</i>	Indic Ocean	01.11.2014	Octopus
06	4	2.8	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central	20.07.2015	–
07	4	2.0	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central	28.08.2015	Octopus, salt, E330, E331, E500
08	4	2.0	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central	20.07.2015	Octopus, water, salt
09	4	1.0	<i>Octopus</i> spp.	Pacific Ocean West-Central	05.05.2015	Octopus
10	4	1.0	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central	09.06.2015	Octopus, water, salt, E331
11	4	1.0	<i>Octopus</i> spp	Atlantic Ocean North-East, Portuguese waters	20.07.2015	Octopus, water, salt, E331
12	4	1.0	<i>Octopus</i> spp	Pacific Ocean West-Central	19.06.2015	–
13	4	1.4	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central (FAO 34)	03.09.2015	Octopus, citric acid, Na citrates, Na carbonates
14	4	1.0	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central	03.08.2015	Octopus, water, salt, E331
15	6	0.8	<i>Octopus vulgaris</i>	Pacific Ocean West-Central	21.07.2015	Octopus, salt, citric acid, trisodium citrate
16	4	1.0	<i>Octopus vulgaris</i>	Pacific Ocean West-Central	02.07.2015	Octopus, salt, citric acid, trisodium citrate
17	4	1.8	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central	30.07.2015	–
18	4	1.5	<i>Octopus vulgaris</i>	Atlantic Ocean North-East (FAO 27), Portuguese waters	21.04.2015	–
19	4	1.2	<i>Octopus vulgaris</i>	Atlantic Ocean Northeast (FAO 27)	13.04.2015	E331
20	4	1.5	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central (FAO 34)	12.12.2014	–
21	4	1.2	<i>Octopus vulgaris</i>	Atlantic Ocean North-East (FAO 27), Portuguese waters	24.12.2014	–
22	4	1.2	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central (FAO 34)	22.08.2015	Octopus, salt, E330, E331, E500
23	4	1.0	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central	03.08.2015	Octopus, salt
24	4	2.0	<i>Octopus vulgaris</i>	Atlantic Ocean North-East (FAO 27), Portuguese waters	11.09.2015	–
25	4	2.4	<i>Octopus vulgaris</i>	Atlantic Ocean East-Central (FAO 34)	17.08.2015	Octopus, water, salt, E 536, E450 e E338

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