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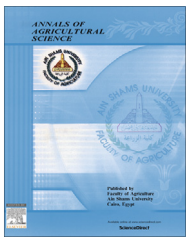

Microbiological quality of imported frozen shrimp in Egypt

Nadia A. Abd-El-Aziz [a,*], **Y.G. Moharram** [b]

[a] *Meat and Fish Technol. Res. Dept., Food Technol. Res. Inst., Agric. Research Center, El-Sabahia, Alexandria, Egypt*
[b] *Food Science and Technology Department, Faculty of Agriculture, Alexandria University, Egypt*

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Abstract This research was undertaken to assess the microbiological quality of 109 samples of the following 7 different products of the imported frozen shrimp in Egypt, block broken peeled, block whole raw, block headless whole, IQF peeled headless, block peeled headless, IQF peeled deveined, and block peeled deveined frozen shrimp through the period 2014–2015. The results showed that the count of shrimp per pound, thawing weight loss, and pH of these products ranged from 20 to 400, from 1.94% to 2.38% and from 7.48 to 7.92, respectively among frozen shrimp products. The mean count of the total viable count (TVC), Enterobacteriaceae, coliform and *Staphylococcus auerus* varied from 4.8×10^3 to 7.7×10^8, from nil to 5.1×10^4, from nil to 4.1×10^3 and from nil to 5.9×10^2, respectively in the aforesaid frozen shrimp products. The count of TVC in 40 and 9% samples of block broken peeled, and block peeled headless frozen shrimp products, respectively was higher than the allowable limit (10^6 cfu/g) in the Egyptian Standards of Frozen Shrimp Specification. Enterobacteriaceae, coliform and coagulase active Staphylococci were detected in some analysed samples but in load less than those recommended by the Egyptian Organization for Standardization and Quality Control (2005). *E. coli* was not detected in any of analysed samples of the 7 frozen shrimp products.

1. Introduction

Several types of shrimp such as pink shrimp (*Panaeus duorarum*), white shrimp (*P. setiferus*), and black tiger (*P. monodor*) are caught from cold or warm brackish to marine and an aquaculture farm water over the world. According to FAO, fresh water species considers prawns and marine species is shrimp. More than 40% of the world shrimp comes from aquaculture (Kanduri and Eckhardt, 2002).

Wet shrimp has a glossy bright coloured shell. It is one of the important crustacean species. The edible part exists in a abdomen part which is enclosed in the rings of shrimp carapace or shell. It represents 24–41% of shrimp weight according to its type, weight, size and age. It contains nearly 71–80% moisture, 0.7–2.3% oil, 18–22% protein in addition to vitamin B group, minerals such as calcium, phosphor, iodine, iron, copper, manganese and zinc (Kaur et al., 2013).

* Corresponding author.
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Shrimp is rapidly spoiled by the active enzymes micro flora in its viscera and the spread yellowish liquid over its abdomen (Mohamed-Hatha et al., 2003). Therefore cooling is essential to keep wet shrimp in good condition. Also, removing the cephalothorax containing organs rich in an autolysis enzymes in addition to use sodium bisulphate alone and/or with food preservatives increases keeping quality of shrimp (Jeyasekaran et al., 2006).

Generally shrimp can be marketed chilled or frozen, peeled and cooked or canned. According to Dore and Frimodt (1987) wet whole shrimp has to be shipped and consumed quickly due to its fast deterioration. The stomach and the rest of the digestive system contain decay organisms which multiply rapidly after the shrimp dies. Fresh headless shrimp keeps much better than whole one (Sasi et al., 2002).

Freezing of shrimp is usually done at −25 to −40 °C in quick freezers. Raw shrimp may be frozen in blocks or individually quick frozen (IQF) using contact plate or air blast spiral freezers. Block frozen product has long storage life and dense brick-like packages which handle and stock easily, and IQF shrimp is easily sold, thawed, cooked without planning a head and without waste. Frozen products include whole raw frozen shrimp, headless frozen shrimp (Tails), peeled or raw headless frozen shrimp without the shell (peeled undeveined, PUD) or tail fin, peeled and deveined frozen shrimp (free from vein, PD), peeled deveined and split frozen shrimp (butterfly frozen product), frozen broken shrimp or pieces of shell on tail or peeled pieces (Dore and Frimodt, 1987). Frozen products are usually packed in cartons lind with polyethylene film with a net weight of 0.25–5 kg or packed in an air exhaust small polyethylene bags in a carton as a secondary container before storing at −20 °C. No shell or legs should be left on the shrimp or in the package. Protection from dehydration and fluctuating temperature during storage and handling maintains the quality of frozen shrimp (Zuberi et al., 1983). Freezing reduces the viable count with the number continuing to fall during frozen storage (Mohamed-Hatha et al., 2003).

Egypt imports large amount of different types of frozen shrimp products mostly from Far East developing countries such as Bangladesh, Pakistan, India, and Indonesia. According to an old FAO report (Anon, 1988), there is a need to maintain quality assurance program during shrimp and prawn processing in several developing countries due to insufficient attention towards standards of hygiene and quality of their production. In India Central Institute of Fisheries Technology (CIFT) and Export Inspection Agency (EIA) adopted the application of international guidelines for food processing such as Hazard Analysis Critical Control Points (HACCP) and European Union (EU) guidelines during producing and processing of frozen shrimp products (Mohamed-Hatha et al., 2003). The imported frozen shrimp products are available in common and super markets in addition to fish and food restaurants in Egypt. The present paper reports the findings of microbiological quality of 109 samples of different imported frozen shrimp products handled and sold in Egyptian markets.

2. Materials and methods

2.1. Materials

The following samples of frozen shrimp products were directly obtained from one of the Egyptian imported food companies through years 2014–2015: 10 of block frozen broken peeled shrimp (pieces), 14 samples of block whole raw frozen shrimp, 8 of block headless whole frozen shrimp, 14 samples of IQF peeled headless frozen shrimp, 35 of block peeled headless frozen shrimp, 16 of IQF peeled deveined frozen shrimp, and 12 of block peeled deveined frozen shrimp. The samples were transported to the laboratory in ice boxes under aseptic condition and stored immediately at −20 °C in deep freezers until microbiological analysis.

2.2. Methods

2.2.1. Microbiological analysis

Frozen samples were thawed over night at 4 °C in refrigerator before analysis. The thawed shrimp muscles without shells were cut to very small pieces using sterile knife and forceps; then, 10 g was homogenized using 90 ml sterile physiological saline (0.85%) solution, and serial decimal dilutions of each homogenate were prepared using the same dilutent for the respective microbiological analysis (Downes and Ito, 2001). Appropriate dilutions (10^1–10^9) were used for enumeration using standard microbiological pour plate technique and recommended culture media of Oxoid (2002). Plate count agar medium was used for enumerating the Total Viable Count (TVC) after incubating at 35–37 °C for 48 h. Violet red bile agar with methyl umbelliferyl glucuronide (VRB-MUG) selective media was used to isolate coliform, gram negative enteric bacteria and rapid detection of *E. coli*. The prepared dilution of frozen shrimp homogenate was inoculated in sterile petri dishes; then, medium was poured and plates were incubated at 37 °C for 18–24 h. Colonies of lactose negative Enterobacteriaceae are colourless and those of lactose positive are red and often surround by a forbid zone due to precipitation of bile acids; meanwhile, light blue fluorescent colonies under UV-Lamp (336 nm) are denoted as *E. coli*.

The recommended Difco Baird Parker agar medium by ICMSF (1978) was used to detect coagulase active *Staphylococcus aureus* after incubating the plates at 35–37 °C for 48 h. The black shiny colonies with narrow white margin and surrounded by clear zones were counted as *Staphylococcus aureus*.

2.2.2. Physical methods

The pH was determined using Testo pH meter, type 230, Lenzkirch Germany, at room temperature (22 ± 3 °C) after mixing 10 g of homogenized sample in 100 ml of distilled water as described in AOAC method (AOAC, 2000). The loss in weight of frozen sample after thawing was calculated as percentage and reported as a thawing loss. The count per pound of the shrimps in each sample was calculated and its range was recorded.

2.2.3. Statistical analysis

Mean, range and standard deviation were calculated as described by Frank and Althoen (1994).

3. Results and discussion

3.1. Physical properties

Results in Table 1 show the count range per pound, thawing loss, and pH of the analysed samples of some Egyptian