

Modified atmosphere packaged (MAP) crustacea: educating consumers' more about the chemical-free preservative method

Charles Odilichukwu R. Okpala, Giocchino Bono, Michele L. Geraci, Eleonora Macaluso, Francesco Di Trapani, Francesca Prestigiacomo, Giacomo Norrito

Istituto per l'Ambiente Marino Costiero-Consiglio Nazionale delle Ricerche, Sicily, Italy. Corresponding author: G. Bono, giocchino.bono@cnr.it

Abstract. Seafood products such as crustacea at postharvest are known to exhibit quality decline. However, to help strengthen solutions toward improving its product development and shelf quality, a number of chemical-free preservative technologies have evolved. Among these include modified atmosphere packaging (MAP) that in combination with other preservative methods shows real-time storage tested success. Moreover, although much attention has been on this preservative method and resultant products, how consumers feel about the preservative methods appear very much neglected. To unify the consumers with not only the knowledge about the preserved product but also the preservative technique is necessary considering the increasing global wave in recent years to go 'green'. Given the experimental success regarding MAP preservative technique thus far evidenced, it could be envisaged in the future that seafood industries might likely embrace this kind of chemical-free food process technology. To put this into context, some big questions would arise, such as: what do consumers really know about this chemical-free preservative method of MAP? Would they (consumers) be willing to actually pay for the resultant preserved product no matter the cost? As consumers' purchase, what should constitute their considerations? Can these reflections help educate consumers better about the chemical-free preservative method of MAP as well as the resultant product? We deliberate/reflect on these abovementioned questions in this present communication.

Key Words: modified atmosphere packaging, consumer education, crustacean products, willingness-to-pay (WTP).

Introduction. Consumers either prior to or at point of purchase of any given product are always occupied with how to ensure their decision(s) to purchase is appropriate and right. Further, consumers have always been the center of seafood (and non-seafood) products. Obviously, this is inevitable as they occupy the end of the supply chain to purchase as well as utilize these products. Seafood products have always included a wide variety of species that play significant role to the food industry (Bono et al 2012). Hence, seafood industry has a very important function at the global scene. In particular, according to the Food and Agriculture Organization (FAO) of the United Nations report regarding the opportunities and challenges with respect to the state of the world fisheries and aquaculture, the fishery sector provides income and source of livelihood to hundreds of millions of people and accounts about a ninth of the global population (FAO 2014).

Among fishery products, the largely free-living aquatic crustacea are well-established seafood product of great economical value. Like other fishery products, consumers appreciate crustaceans due to health benefits, for example, its rich source of protein as well as Omega-3. At postharvest however a number of crustacea species such as shrimp and prawn die and quality begins to decline (Bono & Badalucco 2012; Bono et al 2012; Carlucci et al 2015; Okpala et al 2014; Okpala 2015, 2016; Bono et al 2016). For example, the typical progress of black spot in typical crustacea species is depicted in Figure 1 (A-C). We can see stages of freshly harvested stage up to black spot

symptomology. Bringing solutions to problems such as these are among considerations of high importance to stakeholders associated with this industry.

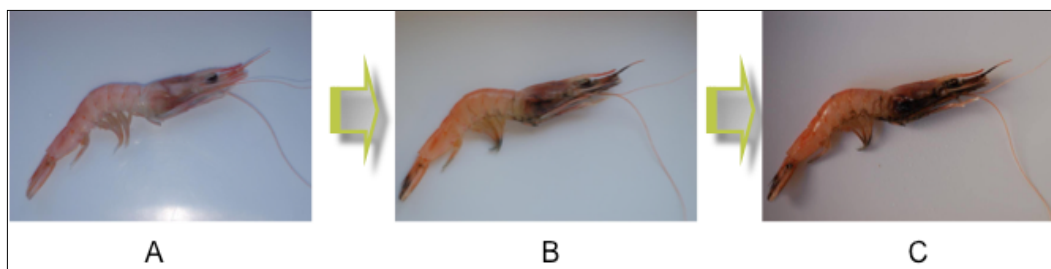


Figure 1. Progress of black spot in a crustacea product: (A) Black spot appears not visible in freshly harvested sample; (B) Black spot gradually appears at head region; (C) Significant black spot as progress is beyond head region.

Rationale of this terse reflection. Improvement of food shelf, quality and product development concerns are among reasons why innovative food technologies are persistently emerging and evolving over the years, for example ozone treatment, modified atmosphere packaging (MAP), high pressure processing, and so on (O'Donnell et al 2012; Okpala 2014, 2015; Bono et al 2016). In particular MAP has been of increasing interest among many researchers probably because in combination with other preservative methods, it shows real-time tested food storage success. It is believed that this approach can supplement the use of chemical treatments (Bono & Badalucco 2012; Bono et al 2012; Zhang et al 2015; Bono et al 2016).

However, while many (as above-cited) studies have focused much on the characteristic qualities of emergent products, how consumers' feel about these preservative methods in its entirety appears left out. This present communication seeks to make consumers better appreciate the usefulness of chemical-free preservative method such as MAP. We start with an attempt to answer the question about what consumers should know of MAP crustacean product with respect to preservative method and resultant product viewpoint, followed by whether consumers would be willing to patronize the product when it is placed on the (supermarket) shelf. We end by deliberating on some key elements that would be helpful for consumers to consider.

What should consumers be educated about MAP crustacea product? Firstly, consumers ought to know what MAP is as a technology. Indeed, it is a well-established technology that has had its application evolved within the food industry for about nine decades (Zhang et al 2015). Consumers also need to know that MAP aims, not only to extend the shelf life, but also essentially to maintain the quality of (sea) food products such as crustacea. Since this communication is inclined to the crustacea species and its product(s), consumers should also be aware that MAP can act in either active or passive manner, active in the sense that the effects can be derived from the respiration rate of crustacea (product) as well as gas permeability of packaged film, or passive by the established steady-state gas composition after long transient period (Costa et al 2011; Zhang et al 2015). Consumers also ought to know that MAP encases the crustacea in packaging with the surrounding headspace that constitute gas mixtures. In addition, the film that enables the encasement of such package can also be selectively permeable (Figure 2a) and sometimes can be a packaging tray built with silicon gum film window and polypropylene (PP) membrane (Figure 2b) (Li & Zhang 2010; Zhang et al 2015). Consumers ought to also know that MAP can adapt an intelligent package system, which enables the monitoring of food product and thus, provides robust quality indicator during the seafood distribution chain. This makes it rather cost effective as well as rapid, reliable, non-invasive and non-destructive (Figure 3) (Zhang et al 2015).

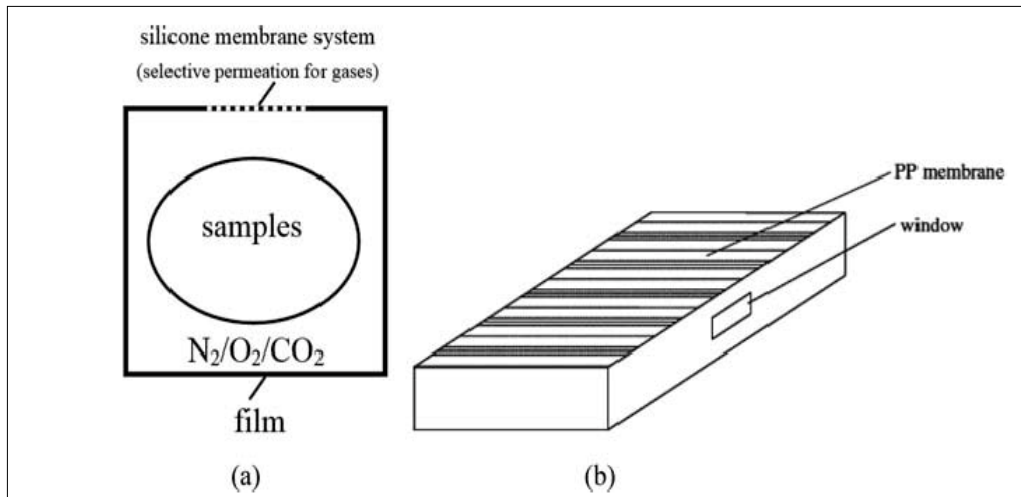


Figure 2. Schematic diagrams of controlled modified atmosphere packaging. (a) Sketch of packaging bag indicating possible gas mix of headspace; (b) Sketch of packaging tray with silicon gum film window and PP membrane (Source: Zhang et al 2015).

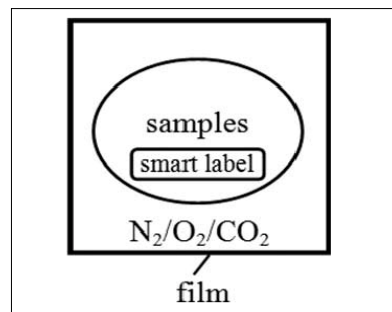


Figure 3. Schematic diagram of intelligent modified atmosphere packaging (Source: Zhang et al 2015).

Moreover, scientific information would require some modifications to allow for better understanding by the non-scientific audience. In this way, the greater majority of audience/consumers would have the chance to better appreciate the potentials of MAP, which is increasingly demonstrating the potential to improve (some) characteristic qualities of seafood products as evidenced in array of scientific publications (Bono et al 2012; Zhang et al 2015; Bono et al 2016). In addition, consumers should know that MAP can be combined with other preservative methods, and this helps to make the food products shelf longer (Bono & Badalucco 2012; Bono et al 2012; Bono et al 2016). Figure 4 shows a typical example of MAP crustacean product produced in our laboratory. Actually, the packaging appears pleasant, marketable and can be acceptable for the supermarket shelf. Santulli & Modica (2009) reiterated that supermarket chains posit itself as rapid dominant force to ease accessibility of products for fishery sector due to its high capacity to satisfy customers' pressing needs, making available seafood products with consistency, quality and size.



Figure 4. A typical example of chemical-free preserved (MAP) crustacean product.

Are consumers willing to pay more for MAP crustacean product? If a potential consumer is either presented with and or sees this MAP crustacean product at the (supermarket) shelf, it will not be remiss to consider how the consumer would perceive this (proposed) chemical-free product. More so, it will be appropriate to also consider whether the consumer would be willing to purchase the product. In opinion of authors herein, there is likely to be a social dimension to this scene as well as the fact that it can also be double faceted, in terms of, the non-chemical preservative method on one side and on the other, the resultant chemical-free preserved product. Besides, to appreciate the willingness to pay (WTP) for the MAP crustacean product should not be difficult for consumers. Specifically, in paying for the chemical-free crustacean product, would it actually depict that the buyer/consumer has accepted either first the crustacean product and thereafter preservative method, or second, vice versa, and or both at the same time? Authors herein believe that the food product is fundamental and comes first prior to the non-chemical preservative (MAP) method. Genuinely, consumers need to have the knowledge as well as means to make informed food choices. This would entail the consumers to bring on board their experiential knowledge, which could help improve their ability to consume the product (Schönfeldt & Hall 2012; Giménez et al 2015; Okpala et al 2015a).

Recently, a research communication has been purposed on the propensity to purchase chemical-free crustacea product. Specifically, it was between consumer types of usual and unusual starting with Italy as a reference case. Primarily, frequent consumers of the crustacean product(s) were classified as the usual consumers whereas on the other hand, those that were much less frequent consumers otherwise occasional in this habit that may either be inconsistent or decreasingly approach zero were classified as unusual consumers. The overall picture was that the periodicity of purchase of 'at least one a month' showed the tendency to be highly ranked between these two major consumer types (Okpala et al 2015a).

The willingness-to-pay (WTP) for a chemical-free crustacea product has been understood to increasingly vary especially when the usual and unusual consumer types are compared, as it moved along the periodicities of purchase (Okpala et al 2015a) (Figure 5). From this communication abovementioned, there could be probable deductions, which may include that, firstly, consumers would be willing to purchase the chemical-free crustacean product placed on the market shelf and secondly, both cultures and traditions of individuals might contribute to influence the willingness to purchase the non-chemical preserved product.

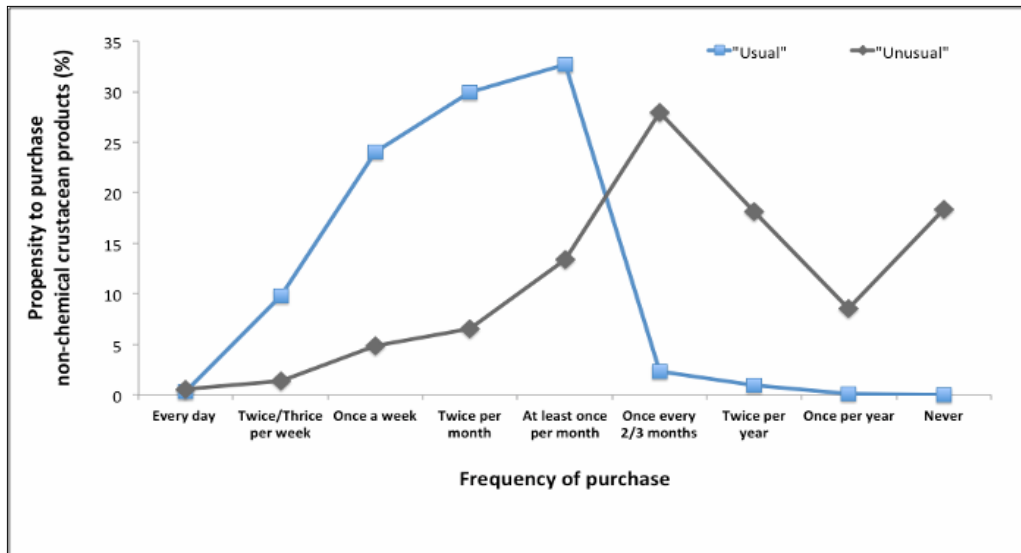


Figure 5. The propensity to purchase chemical-free (MAP) crustacean product between usual and unusual consumers as function of frequency of purchase (Source: Okpala et al 2015a).

Price-quantity-periodicity of purchase: can consumers be more convinced? Prior to the wrap-up of this paper, authors' herein feel it is needful to take into account what consumers would likely consider either prior to or at the point of purchase of a given MAP crustacean product. We reckon that consumers will likely not behave in the same manner at purchase of the crustacea species especially when there have the information about the kind of preservative treatment method that has been delivered on the product and vice versa (Okpala et al 2015a). In such context, a number of questions would arise in the thoughts of potential consumers, for example, (a) In their respective home as they (consumers) draw-up their shopping list(s), could they be aware that the MAP crustacean product(s) exist in the supermarket? (b) If at the supermarket, these customers see the MAP crustacean product and possibly with a higher price tag compared to the conventional ones, how receptive would the consumers be to the new product? (c) If they (consumers) eventually agree to purchase the product, what quantity would suffice for the now and probably for subsequent days (dependent on family size, of course)? (d) If after first consumption and it is well received and more gets desired, what frequency would subsequent purchase(s) of the MAP product be? In the context of the (above) questions therefore, what would be the key considerations for these potential consumers? Authors herein opine that price, quantity and periodicities of purchase would likely be at the top of factors considered by consumers particularly regards to the purchase of MAP crustacean product (applicable as well to other products of interest). To this end and in agreement with recent report (Giménez et al 2015) and in order to help consumers make appropriate food-related decisions, considerations should be given to direct/indirect factors such as attitudes, beliefs, information about the desired product as well as past experiences.

A recent research communicated the discourse of price-quantity-periodicity of purchase. Figure 6 shows the schematic representation of price-quantity-periodicity of purchase as function of consumer types. For emphasis, the product purchase by quantity axis is represented by 'kilograms (kg)' whereas the periodicity of purchase axis is represented by 'Days'. The continuous trend line represents the non-chemical treated product (as in this case is modified atmosphere packaging (MAP) crustacean product) whereas the dotted trend line represents the chemical treated ones. Clearly, this scheme allowed for useful comparisons between chemical- and non-chemical treated (crustacea) product(s) by periodicities of purchase and consumer types. In addition, the use of price, quantity and periodicity of purchase would allow for direct association between the consumer types and chemical /non-chemical preservative methods as the different trends by comparisons are demonstrated (Okpala et al 2015b). Thus, bringing the chemical-free preservative method of MAP and its resultant product closer to the consumers appears

feasible and realistic. For consumers, the price, quantity and periodicities of purchase of the MAP product(s) can be considered as key factors/prerequisites prior to its purchase. Following this, the availability of information about the desired MAP product(s) will be of high importance. In this circumstance, the consumers need to be well convinced and this can only be realized when they believe that: (a) making the purchase is important/vital; (b) that they need to learn more, as well as (c) that they can easily obtain improved information about the product. Consequently, more information search by consumers would be required (Punj & Staelin 1983; Okpala et al 2015b).

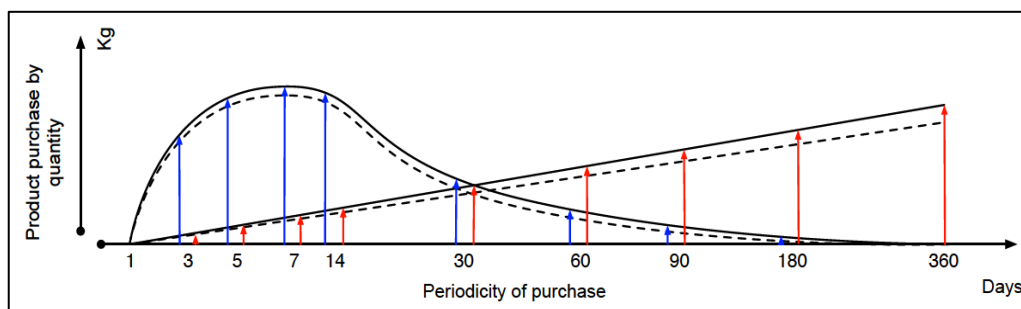


Figure 6. Schematic representation of price-quantity-periodicities of purchase as function of consumer types applicable to chemical- versus chemical-free (crustacea) product(s). Product purchase by quantity (kilograms {kg}), periodicity of purchase (Days), axis arrows 'blue' = usual consumers and 'red' = unusual consumers (Source: Okpala et al 2015b).

Concluding remarks. We have attempted to demonstrate avenues that would help consumers to become more aware about non-chemical preservative method of MAP as well as the resultant product. We presented some basics that consumers need to know with regards to this chemical-free food preservative method. This was followed by a brief discourse about the willingness to pay for the resultant product. Subsequently, we relayed some considerations that could be termed as 'prerequisite(s)' prior to purchase. Undeniably, the present communication reveals the import as well as need to unify the consumer(s), the new preserved product(s) as well as the food preservative technique. This is of great essence considering the increasing global wave to go 'green'. In the near future, there is less doubt that seafood industries may likely embrace MAP as well as other related/relevant emerging and promising food technologies purposed towards commercialization considering the many promising experimental research successes evidenced thus far.

References

- Bono G., Badalucco C. V., 2012 Combining ozone and modified atmosphere packaging (MAP) to maximize shelf-life and quality of striped red mullet (*Mullus surmuletus*). LWT-Food Science and Technology 47(2):500-504.
- Bono G., Badalucco C. V., Cusumano S., Palmegiano G. B., 2012 Toward shrimp without chemical additives: a combined freezing – MAP approach. LWT-Food Science and Technology 46(1):274-279.
- Bono G., Okpala C. O. R., Alberio G. R. A., Messina C. M., Santulli A., Giacalone G., Spagna G., 2016 Toward shrimp consumption without chemicals: combined effects of freezing and modified atmosphere packaging (MAP) on some quality characteristics of giant red shrimp (*Aristaomorpha foliacea*) during storage. Food Chemistry 197:581-588.
- Carlucci D., Nocella G., De Devitiis B., Viscecchia R., Bimbo F., Nardone G., 2015 Consumer purchasing behavior towards fish and seafood products. Patterns and insights from a sample of international studies. Appetite 84:212-227.
- Costa C., Lucera A., Conte A., Mastromatteo M., Speranza B., Antonacci A., Del Nobile M. A., 2011 Effects of passive and active modified atmosphere packaging conditions on ready-to-eat table grape. Journal of Food Engineering 102(2):115-121.

- FAO, 2014 The state of world fisheries and aquaculture. Opportunities and challenges. Rome, Geneva: Food and Agriculture Organization of the United Nations, World Health Organization, 243 pp.
- Giménez A., Gagliardi A., Ares G., 2015 Influence of evoked contexts on consumers' rejection of two products: implications for shelf life estimation. *Food Research International* 76(3):527-531.
- Li T., Zhang M., 2010 Effects of modified atmosphere packaging (MAP) with a silicon gum film window and storage temperature on the quality and antioxidant system of stored *Agrocybe chaxingu*. *LWT-Food Science and Technology* 43:1113-1120.
- O'Donnell C., Tiwari B. K., Cullen P. J., Rice R. G., 2012 Ozone in food processing. United Kingdom, Wiley-Blackwell, 312 pp.
- Okpala C. O. R., 2014 Investigation of quality attributes of ice-stored Pacific white shrimp (*Litopenaeus vannamei*) as affected by sequential minimal ozone treatment. *LWT-Food Science and Technology* 57:538-547.
- Okpala C. O. R., 2015 Quality evaluation and shelf life of minimal ozone-treated Pacific white shrimp (*Litopenaeus vannamei*) stored on ice. *Journal für Verbraucherschutz und Lebensmittelsicherheit* 10(2):49-57.
- Okpala C. O. R., 2016 Lipid autoxidation in ozone-processed crustacea under cold storage: a treatise. *Lipid Technology* 28(5-6):93-95.
- Okpala C. O. R., Choo W. S., Dykes G. A., 2014 Quality and shelf life assessment of Pacific white shrimp (*Litopenaeus vannamei*) freshly harvested and stored on ice. *LWT-Food Science and Technology* 55(1):110-116.
- Okpala C. O. R., Bono G., Gancitano V., 2015a Consumer propensity to purchase non-chemical treated crustacean product: a case study of Italy. *AAFL Bioflux* 8(6):839-845.
- Okpala C. O. R., Bono G., Norrito G., 2015b Comparing chemical and chemical-free crustacean products: hypothesis of price-quantity-periodicity of purchase (P-Q-P) by consumer types. *AAFL Bioflux* 8(6):946-951.
- Punj G. N., Staelin R., 1983 A model of consumer information search behavior for new automobiles. *Journal of Consumer Research* 9(4):366-380.
- Santulli A., Modica A., 2009 Aquaculture in Sicily: the state of the art. *Italian Journal of Animal Science* 8(2):829-837.
- Schönfeldt H. C., Hall N. G., 2012 Consumer education on the health benefits of red meat – a multidisciplinary approach. *Food Research International* 47:152-155.
- Zhang M., Meng X., Bhandari B., Fang Z., Chen H., 2015 Recent application of modified atmosphere packaging (MAP) in fresh and fresh-cut foods. *Food Reviews International* 31(2):172-193.

Received: 02 June 2016. Accepted: 27 June 2016. Published online: 30 June 2016.

Authors:

Charles Odilichukwu R. Okpala, Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Via L. Vaccara 61, 91026 Mazara del Vallo, Italy, e-mail: charlesokpala@gmail.com
 Gioacchino Bono, Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Via L. Vaccara 61, 91026 Mazara del Vallo, Italy, e-mail: gioacchino.bono@cnr.it
 Michele Luca Geraci, Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Via L. Vaccara 61, 91026 Mazara del Vallo, Italy, e-mail: michele.geraci86@tiscali.it
 Eleonora Macaluso, Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Via L. Vaccara 61, 91026 Mazara del Vallo, Italy, e-mail: gaeruul@gmail.com
 Francesco Di Trapani, Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Via L. Vaccara 61, 91026 Mazara del Vallo, Italy, e-mail: fraditrapani@iol.it
 Francesca Prestigiacomio, Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Via L. Vaccara 61, 91026 Mazara del Vallo, Italy, e-mail: aplysia82@alice.it
 Giacomo Norrito, Istituto per l'Ambiente Marino Costiero, Consiglio Nazionale delle Ricerche, Via L. Vaccara 61, 91026 Mazara del Vallo, Italy, e-mail: giacomo.norrito@cnr.it

This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

How to cite this article:

Okpala C. O. R., Bono G., Geraci M. L., Macaluso E., Di Trapani F., Prestigiacomio F., Norrito G., 2016 Modified atmosphere packaged (MAP) crustacea: educating consumers' more about the chemical-free preservative method. *AAFL Bioflux* 9(3):768-774.