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A Review on Effects of Modified Atmosphere Packaging on Quality and Safety of Fresh Meat and Meat Products

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Abstract:

Good nutritive, sensory quality, safety and long shelf life of food products is the first priority of the consumers. The main objective of this study was to review available published literature on modified atmosphere packaging of food products. In this review, fresh meat is considered as a food products. To identify the freshness at the time of purchasing, sensory quality and especially colour of meat is checked. Findings of best gas mixture that keep fresh meat initial colour, its stability, and shelf life of product for minimizing the growth of microorganism lipid oxidation and to provide safe product is being focused in recent advances of modified atmosphere packing. Food industry developed modern technology of using modified atmosphere for food packaging to fulfill these goals.

Keywords: *Modified atmosphere packaging, fresh meat quality, safety*

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Introduction

The life style of human has been changed from previous eras more than expectations. As the demands of consumers is increasing, food industry has developed new modern technologies of packaging to satisfy consumer's demands. The individual expectations of nutritive and sensory food quality are the crucial for the acceptance of the product development which are the main concepts of quality of food. There ar enumbe of changes occurred in economically developed societies like consumers eat more meal away from home, use food items that need minimal preparation, fresh like properties, and of long shelf life. Shelf life is the period of time in which a product can be stored without being sensory unacceptable and becoming a health risk (Koch *et al*., 2009). It also include the deterioration from chemical and microbial contamination.

Meat quality and safety

Food quality is interrelated with safety and nutrition or it can say that all are strongly interrelated with each other. Due to the changing eating habits, changing of products, increased population and increased food infection, food safety became more and more genuine. Peoples are preffering more and more to convenience ready to eat products than the hours cooking due to which, demands of cold chain in the market initiated new meat products and prodct presentation. For fulfilling the special standards and requirements for food products with acceptable level of quality, food systems must be implemented. Vacuum packaging and modified atmosphere have been gaining importance as preservation techniques to improve the shelf life of meat and other foodstuffs as it is the recent innovations. Air is completely removed in vacuum packaging whereas in the packing of modified atmosphere packaging, it provides alterations of atmospheric gas concentrations. The selected atmospheric concentration of gas is actively maintained throughout the storage peiod however, controlled atmosphere packaging is also a modified atmosphere packaging. Retention time of meat color is much more in modified atmosphere packaging than in vacuum packaging but microbial profiles of meat packed with both manner do not differe significantly.

The quality of products can be improved by coupling with hurdle technology and proper preservagtion systems and it can be retained by the m\several advantages offered by the modified atmosphere packaging. A significant area of advancement of modified atmosphere packaging is active packaging that improves the safety of meat products and other foodstuffs which are important in human nutrition. Many factors such as color change, lipid and protein oxidation and spoilage by microorhanisms affects the quality of chill stored fresh meat but for their protection different standards can be implemented.

Packaging gases as food additives

Compulsory indication of certain foodstuffs is necessary to provide for ensuring the receiving of adequate information of consumers. The packaging gases used for the packaging of sevral foodstuffs should not be placed in the list of ingredients on the label as it should not be taken as ingredients purpose. Consumers must be well known about the packaging gas that why this gas is encorporated with the food stuff the purchased and have longer shelf life than the other products packed with different way. Modified atmosphere packaging is a technology to reduce oxygen concentration surrounding the food products. This method is well known to extend the shelf life of avariety of foods, including fresh meat. For maintenance of the quality of fresh red meat both from microbiological and sensory point of view, atmosphere generally combines oxygen, carbon dioxide and nitrogen in different proportion. To increase the effect of modified atmosphere packaging it should be used with refrigeration as it lowers the temperature and hence slowed down the microbiological and other kinds of food products spoilage. The protection of oxidation of food products includes fat and aromatic substances is done by the modified atmosphere packaging method which increases the shelf life preservation of product quality, easy separation of sliced products, clear visible product, little or no need for chemical preservation, increased distribution area and reduced costs. The commonly applied substances on the fresh meat and meat products are oxygen, carbon dioxide, nitrogen and carbon monoxide.

- **Oxygen**

Aerobic spoilage organism metabolically using oxygen gases which the major factor for the determination of shelf life. The major function of the oxygen gas in meat is to maintain myoglobin into oxymyoglobin (oxygenated form). The bright red color of the red meat is brought about by the oxygen gas but it is also reaponsible for decreasing shelf life of meat in some oxygen sensitive products. For ensuring the color stability, more sonsistent, juicy and tender product, injection enhancement of fresh meat is adopted by the meat industry. There are many problems generated in storage in high oxygen atmosphere ie, decrease meat tenderness and reduced content of free protein compared to packaging without oxygen which results in the oxidation of meat products while keeping in high oxygen atmosphere.

- **Carbon Dioxide**

Carbon dioxide retards the bacterial growth by increasing the lag phase and generation time of spoilage organisms through which the shelf life of perishable foods extends. Modified atmosphere packaging overcome many disadvantages of the vacuum packaging techniques and become more common to apply on different meat products. Microbial growth phase is the factor on which the efficacy of the carbon dioxide depends. The formation of metmyoglobin causing the certain degree of darkening is the major disadvantage of high carbion dioxide concentration in meat modified atmosphere packaging especially in case of lower oxygen concentration.

- **Nitrogen**

Nitrogen has lower solubility in both water and fat and is an inert gas. It displaces the oxygen and influence the shelf life of perishable product by retarding the growth of aerobic spoilage microorganism indirectly is the main function in modified atmosphere packaging. It does not affect the color of meat because it has not antibacterial properties.

- **Carbon Monoxide**

The other component of the modified atmospghere packaging is the carbon monoxide which is the 0.4 percent of the total component. Fresh cuts of muscles meat and ground meat is packed through this packaging system which maintain the wholesomeness, provides fascility in distribution and reduces shrinkening of the meat. Carboxymyoglobin is formed simply by implicating the strong affinity of deoxymyoglobin for carbon monoxide to produce a stable red color to the muscle and this is explained by the most meat researchers so the meat color can be preserved by the carbon monoxide.

Review of Literature

Fonseca, Oliveira and Brecht (2002) discussed the major methods for measuring respiration rates along with their advantages and limitations in this review on modelling respiration rate of fresh and vegetables for modified atmosphere packages. Also reviewed respiration rate models in the literature and said more research is needed in this area. Respiration rate is enfluenced by the variables of the fresh cut products such as preparation method, cutting size and time after cutting.

Ozogul, Polat and Ozogul, (2003) discussed the effects of modified atmosphere packaging and vacuum packaging on chemical, sensory and microbiological changes of sardines. Air stored sardine has the highest concentration of tetramethyamine then sardine stored in vacuum packaging and lowest in modified atmosphere packaging. In their work, they found the freshness indicators, K- and Ki-values, are superior to H-value and G-value and provided useful freshness indices for sardines in MAP and VP.

Arashisar *et al.*, (2004) worked on effects of modified atmosphere and vacuum packaging on microbiological and chemical properties of rainbow trout fillets and found that the bacterial growth is increasingly depressed by higher concentrations of CO_2 and oxidation products are depressed by lower concentrations of oxygen. The atmosphere surrounding the pack will have a higher concentration of oxygen and nitrogen than the original mixture by dissolving much of the carbon di oxide in the flesh.

Diana, *et al.*, (2007) reviewed the study of extending and measuring the quality of fresh cut fruit and vegetables. For the sanitzation of fruits and vegetables in the fresh cut industry, chlorine solution is used. They suggested the need to find substitutes of fresh cut fruits and vegetables for improving the ability of washing treatments. The association of chlorine with the possible formation of carcinogenic chlorinated compounds in water has called into question to the usage of chlorine in food processing.

Caleb, Opara and Witthuhn, (2011) worked on review of modified atmosphere packaging of pomegranate fruit and arils, and highlights the current status and applications of modified atmosphere packaging in whole fruit and minimally processed pomegranate arils and also identified the future prospects. Retardation of produce respiration rate and extend the shelf of fresh produce is possible due to the modified atmosphere packaging.

Caleb *et al.*, (2012) reviewed the effects of modified atmosphere packaging on the microbiological safety of fresh or fresh cut producewhich includes the role of innovative tools such as the use of pressurized noble gases. Fresh food quality and microbial safety in packaging technology is insured by the integration of hazard analysis and critical control point based programs.

Mangaraj, Goswami and Mahajan, (2015) reviewed on application of plastic films for modified atmosphere packaging of fruits and vegetables. Modified atmosphere packaging of fresh produce is depend on the modification of atmosphere within the package. This is achieved by the natural reaction of the two peocesses which are respiration rates of commodity and permeability of the packaging films. They used polystyrene as a permeable packaging films.

Conclusion

In todays, the consumers gives more priority to nutritive and sensory quality, attractive appearance and safety of meat products. The meat industry has changed from being production driven to becoming consumer led in modern business conditions. Modified atmosphere packaging us widely being used commercially for controlling the biological contaminants as critical point in oprder to make safe meat and meat products and to increase the shelf life of meat and maintain a desirable bright red colour as important quality feature. Dealing with further consumer oriented research and improvements related to the mjosified atmosphere packaging combined with new methods of fresh meat color stabilization, maintenance of fresh meat odour, slow down of oxidative reactions and extending meat shelf life by inhibition of spoilage bacterial growth is the other challenge or researchers and meat producers in future.

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