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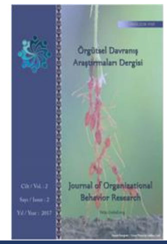

Examination of Physico-Chemical Changes of Industrially Produced Meat Chips Under Ambient Temperature

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ABSTRACT

Considering the growing number of diseases caused by consuming high-fat levels in unlawful foods, it is important to produce low-fat or fat-free products. Meat chips and fast foods are increasingly consumed by most people, especially children and young people in society; these products, unfortunately, contain high levels of oil and are detrimental to consumers' health. Thus, the production of low-fat chips with good properties can effectively increase public health. The research found that various variables such as starch concentration, glutamate and temperature had a significant impact on the chemical properties of meat samples. An examination of the effect of different starch concentrations on the Total Volatile Basic Nitrogen (TVB-N) and peroxide suggested that different concentration levels had an additive effect on this index. The temperature was also found to affect the TVB-N index. As the glutamate content increased, the TVB-N index and peroxide increased, also. This means that sodium glutamate can increase amino-peroxide compounds in meat samples.

Keywords: *meat chips, glutamate, starch, low-fat products*

INTRODUCTION

Today, lack of enough time and occupational problems have made people increasingly turn to eat fast foods. Consistent with the rising demands, the production of fast foods has also increased. Today, people in society suffer from such diseases as diabetes, obesity, cardiovascular diseases, etc., with most nutritionists and health experts warning that high levels of fat in people's diets may account for such diseases. Fast foods and chips are products that are increasingly consumed by most people, especially children and young people in the community. Red meat, which contains high protein, energy, vitamin B, minerals, and amino acids, is considered a valuable nutritious food source (Cheraghi et al., 2010).

Since aquatic meat also contains minerals such as iron, selenium, iodine, calcium, magnesium, etc., and omega-3 fatty acids such as icosapentaenoic acid and docosahexaenoic acid, they have a special nutritious meat status. Consistent with clinical studies, consuming fish and aquatic products can considerably impact the prevention and even treatment of many diseases (Azizi et al., 2001). In addition to protein, chicken meat contains various vitamins and minerals, including selenium, niacin, the amino acid tryptophan and phosphorus (www.seemorgh.com).

Today, processed meat products take a big chunk of the family's food basket. One of the meat products is sausage, which is widely consumed because of its cheaper price and more favorable taste than conventional meat and its easy and fast preparation. One of the factors that cause an undesirable taste and reduce the quality of meat products is fat oxidation due to the degraded fat-soluble vitamins and unsaturated fatty acids (Gray et al., 1996). Processed meats, including sausages, largely use sodium or potassium nitrite as preservatives which prevent the growth and production of neurotoxins by clostridium botulinum, prevent the spread and production of spoilage microorganisms, and delays the spread of oxidative degradation; it also stabilizes the color of the red meat and affects the color and taste of the product by reacting with myoglobin (Cammack et al., 1999).

However, high nitrite consumption is detrimental to human health as it causes allergic effects and vasodilation and produces metmyoglobin in tissues. Furthermore, nitrous acid may react with secondary amines and amino acids naturally found in meat foods to form N-nitroso compounds, especially nitrosamines. These compounds are highly active and toxic and cause carcinogenic and neurological effects (Karl-Otto et al., 2008).

According to Iran's National Standards, the authorized consumption level of sodium or potassium nitrite is 120 mg/kg in the final product. Chips and fast foods are products increasingly consumed among most people, especially children and youth in the society (Amir Daraei et al., 2008). Meat chips, produced from types of meats such as fish, poultry, etc., are easily consumed types of meat. Today, because the consumption of fast foods is on the rise, the production of low-fat, low-cholesterol, high-protein, and high-nutrient foods is becoming a critical factor (Elena M. & Morales Sosa, 2006). Produced in some countries of the world, meat chips are made of pieces of meat mixed with water, starch, flavorings, etc., then producing paste. Having been dried, the paste is cut into thin layers that are dried and then fried in hot oil (Conley & Piaomak, 1965).

Chips (food snacks) are one of the globally unique fast-food items whose biological properties increase when produced from meat containing a high biological value. Converting meat to products such as chips provides a new solution to consuming dry, solid and low-water meats, making fast food products easy to digest.

Red Meat and its Perishability

Meat is considered to be one of the most important sources of protein. The fact that meat is rich in valuable proteins with essential amino acids for the body, minerals, especially iron and zinc, types of vitamins, and adequate energy make it one of the perfect foods. The meat obtained from the slaughter of halal-meat domestic animals such as bulls, buffalo, sheep, goats and camels have a red-pink color as it is rich in myoglobin and is thus called red meat. Data from the Statistical Center of Iran suggest that the production of red meat in Iranian slaughterhouses was 403 thousand tons in 2009, and the imports were 105 thousand tons by the same year. Because the data do not provide any information on unauthorized slaughter, if the missing figure stands at about 30% of the total slaughter, as experience has shown, the total amount of red meat produced domestically will amount to 524 thousand tons, while the total amount of red meat consumed will be 629 thousand tons (Shekarforoush et al., 2012).

From 2008 to 2013, red meat production dropped by 30% due to various reasons such as the old production technology, rising prices, and declining exports and imports (The Statistical Center of Iran).

From an economic and nutritional perspective, the importance of consuming meat has led to extensive studies on microbial contamination and regional diseases in various countries. This is because healthy nutrition is one of the main elements of public health, and lacking solutions warrant critical solutions to analyze and test meat (Farshchian et al., 2010).

The microbial status of red meat and poultry meat depends on animal husbandry, slaughtering and processing. Slaughtering is the most critical stage regarding meat contamination, with a significant part of the contamination also seen in subsequent operations. The initial contamination of the meat surface of healthy livestock is affected by livestock conditions and the slaughterhouse environment. Following the slaughtering stage, subsequent stages, including transportation, cooling, drying, processing, packaging, and storage of the carcass, determine which bacteria survive from the original microbial population of the carcass and form the dominant population.

Different studies have suggested that the decortication operation causes the bacteria to transfer to the carcass. In the post-decortication process, the number of bacteria increases slightly on the carcass but displacing the carcass and performing operations on it cause the bacteria to spread on the carcass, as the number of bacteria on the carcass follows a natural logarithmic rule (Ekhtiarzadeh & Jahan Pima, 2002). As a result, meat can be easily contaminated with various microorganisms, and if transportation and storage conditions are not met, spoilage and pathogenic bacteria will grow, thus, reducing the quality of meat and endangering public health (Vernozy-Rozand et al., 2002). Refrigerated storage is the most prevalent method of storing meat and meat products. In some countries, antimicrobials and antioxidants, often used in synthetic forms, increase the shelf life of meat and meat products. Today, however, consumers are gaining more knowledge of the side effects of chemical preservatives and are thus demanding fresher, more natural, and more controlled foods (Akgul and Kivanc, 1988).

Given the health hazards caused by pathogenic bacteria in foods, it is becoming important to gain knowledge of the past and present situation of bacterial contamination of food of animal origin with food-borne bacteria and to evaluate these contaminants to provide appropriate solutions to eliminate or reduce them.

Food-borne illnesses are among the most notorious public health problems across the world. Despite modern technologies such as high-quality production, health and quality control, and the establishment of Hazard Analysis Critical Control Point (HACCP), the number of food-borne illnesses has risen compared to the past decade. The rising trend of food sales across the world, the introduction of new foods, modern food processing and the rising public demand around the world for the consumption of foods as well as fast foods, less subject to different processing methods, have largely increased the microbial contamination of foodstuff (Garcia et al., 2010).

Monosodium Glutamate

Monosodium glutamate or MSG has the chemical formula of C5H8NNaO4 and a white crystalline powder form used as a flavor enhancer and intensifier. Monosodium glutamate is widely used to produce meat products, chips, canned goods and broth tablets. Monosodium glutamate (MSG) is one of the most popular flavor enhancers whose health and consumption is under question. The appearance of this substance is like salt or sugar crystals, which has no taste by itself, though it intensifies other tastes and creates a good taste. Monosodium glutamate is the sodium salt of glutamic acid, one of the twenty nonessential natural amino acids for the human body, almost found in all foods, especially foods rich in proteins such as dairy products, meat, fish and many vegetables. Hydrolyzed vegetable protein (HVP), soy sauce and many other fruits such as tomatoes and grapes and other conventional foods such as cheese and mushrooms contain high levels of free glutamate. Some scientists maintain that glutamate is the fifth taste, i.e., savoriness in addition to saltiness, sweetness, sourness and bitterness.

Literature Review

Salam et al. (2004) examined the antioxidant and antimicrobial effects of garlic against fat oxidation and microbial growth in chicken sausages, concluding that the use of fresh garlic (30 g/kg) or garlic powder (9 g/kg) could significantly reduce the overall aerobic bacteria count, and consequently increase the shelf life. However, the addition of GO or BHA made no significant difference to APC compared to the control sample. Sensory analysis suggested that FG created a more significant odor and flavor than other substances. Consistent with the findings, fresh garlic and garlic powder were potentially useful to preserve meat products because of their antioxidant and antimicrobial properties.

Cherian et al. (2005) demonstrated that chicken meat and eggs are widely available and relatively cheap, which can also be major sources of essential nutrients, especially for the poor; they also concluded that the prevalence of metabolic diseases caused by deficiencies of vitamin nutrients could be compensated for by consuming chicken meat.

Cudahy (2005) used pork to produce chips. He processed the pieces of the meat at the cooking temperature of 130°F (54.4°C) to bring it out of the raw meat, which helped it be used again. The chips were placed in a package, and then the moisture, protein and fat of the intended product were analyzed.

Zhang and Barbute (2005) examined the effect of adding potato and tapioca starch on DFD, PSE of chicken breast. Following the addition of starch and cooking at 75°C and then cooling to 30°C, they found that the DFD product was experiencing more brittleness than the PSE product; however, on the other hand, the product texture improved with the addition of starch because of the increased water absorption and water holding capacity, increased binding of protein and water, and increased viscosity of meat paste. Meanwhile, the added starch could compensate for the functioning of the protein in the PSE product.

In a study, Devalakshmi et al. (2010) examined the physicochemical, microbial and sensory quality of chicken meat chips. Ingredients such as baked potatoes (starch) (15%), cornflour (3%), common salt (2%), baking powder (0.5%), spices (1.5%), ginger and garlic (2%) were added to the chips, and the final product was exposed to the hot air of 100°C for 2 hours; then the chips were packed in 60-piece packages. Considering the control and storage processes, the intended packages were stored at 37°C and 7°C for eight weeks. The results suggested that chips made of 15% flour formulation were more acceptable for up to 8 weeks at both 37 and 7°C in the storage process.

Izci et al. (2010) examined the production of fish chips from sand smelt (Atherina boyeri), noting some qualitative changes during the storage period at -18°C for six months. Here, the mixture was made from 60% minced fish, 11% starch, 21% cold water, 5.5% potato flour, 1.85% salt, and 0.65% monosodium glutamate. The mixture had a length of 10 cm and width and thickness of 1 cm, which, having been fried in sunflower oil at 190°C for 6 seconds, was subjected to a cold shock, i.e., -18 ° C, and then stored at this temperature. Microbial and chemical analyses were subsequently carried out on it. The findings showed a significant difference in the values of moisture, ash, protein and crude fat of raw fish and fish chips. The initial frying process reduced all fatty acids except oleic acid and linoleic acid. An insignificant difference was noted between the values of thiobarbituric acid and pH of raw meat samples and initially fried chips, while a significant difference was noted in the values of Total Volatile Basic

Nitrogen. Later, a microbiological analysis was carried out on it, demonstrating a reduced number of microorganisms at the end of the storage time. Chemical analysis results suggested that the microbiological sensitivity of fish chips was at an acceptable level during the frozen storage at -18°C after six months. This was thought of as one of the first processing technologies for fish species.

Considering the health and nutritional hazards of fried potato chips, Parsapour et al. (2004) examined the possibility of removing the frying stage of producing potato chips. Results of various production methods found that the drying method can be good for this end. To this aim, the chips, having been dried, were sprayed on with the hot and cold (75-80) oil of 0, 5 and 10% rates. Six samples were evaluated, showing no significant differences from the control sample regarding sensory properties.

Methods and Procedure

Substances and Equipment

Chips paste was prepared from beef, corn flour, corn starch, sodium chloride, antioxidants, sodium glutamate, garlic powder, ginger, and spices. Chemicals including nitrobenzene, 4N nitric acid, potassium ferrocyanide, zinc acetate, 0.1n silver nitrate, potassium thiocyanate, ammonium sulfate, hexane, 4N ric chloride, sulfuric acid, methyl red reagent, crystalline copper sulfate, selenium dioxide and 2% boric acid were purchased from the German company of Merck.

Peroxide Number Measurement

The Egan et al. (1997) technique measured the peroxide index.

TVBN (Total Volatile Basic Nitrogen) Measurement

The measurement was carried out based on the AOAC technique (2002).

Data Analysis Method

Microsoft Excel (version 2010) was used to plot the curves, while the Minitab software (version 14) was used to perform the statistical analysis. Mean data was compared by the Duncan test, with the statistical difference considered to be less than 5% of the significance level. Sensory evaluation results were analyzed using a 9- point Hedonic Ranking Scale.

Results and Discussion

Examining the response surface diagram of the simultaneous effect of starch and glutamate concentrations on The TVBN (Total Volatile Basic Nitrogen) in the third month under ambient temperature

Figure (1) illustrates that initially, as the glutamate concentration increases from 0.5 to 0.6%, the TVBN index decreases; however, as the concentration increases from 0.6 to 0.7%, the TVBN index increases upwards. Starch also had a similar trend on the TVBN variations, with a concentration of 10 to 12.5% causing the index to decrease, while a concentration of 12.5 to 17.5% caused the index to increase. Generally, these two compounds had an increasing effect on the TVBN. Regression coefficient results suggested that the effect of these two compounds on TVBN variations was not significant. The presence of amino acids in glutamate's structure can increase this index.

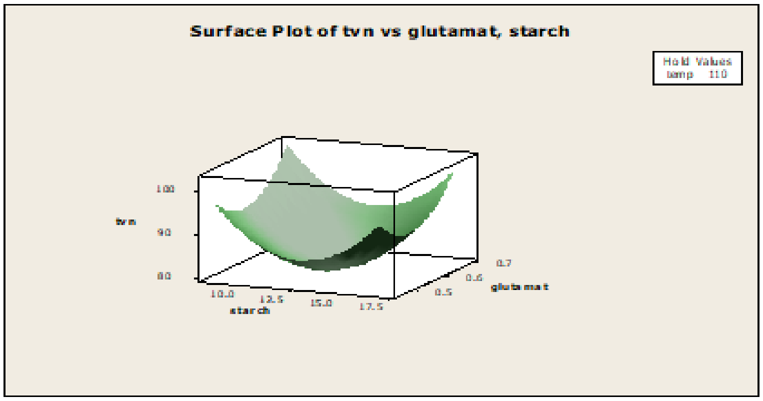

Figure (1): Mutual effects of starch and glutamate concentrations on the TVBN in the third month at ambient temperature

Examining the response surface diagram of the simultaneous effect of starch concentration and temperature on the TVBN in the third month under ambient temperature

Figure (2) illustrates that the TVBN index first decreases and then increases as temperature increases. Also, a review of starch concentration variations on the TVBN found that low concentrations of starch cause this index to decrease, but higher starch concentrations increased the index. Regression coefficient results determined that the effect of these two compounds on TVBN variations is significant at the 5% level. Heat also causes denaturation and the production of volatile compounds such as ammonia. Degradation of protein compounds and peptide bonds was found to increase with temperature increase.

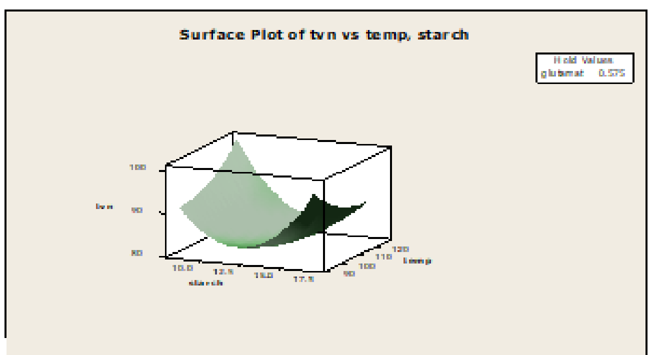

Figure (2): Mutual effects of starch concentrations and temperature on the TVBN in the third month at ambient temperature

Examining the response surface diagram of the simultaneous effect of glutamate concentration and temperature on the Total Volatile Basic Nitrogen (TVBN index) in the third month under ambient temperature

Figure (3) illustrates that initially, as temperature increases, this index decreases, then increases. A similar trend was noted of glutamate concentrations. Regression coefficient results determined that the effect of these two compounds on TVBN variations is not significant. Both compounds increased TVBN.

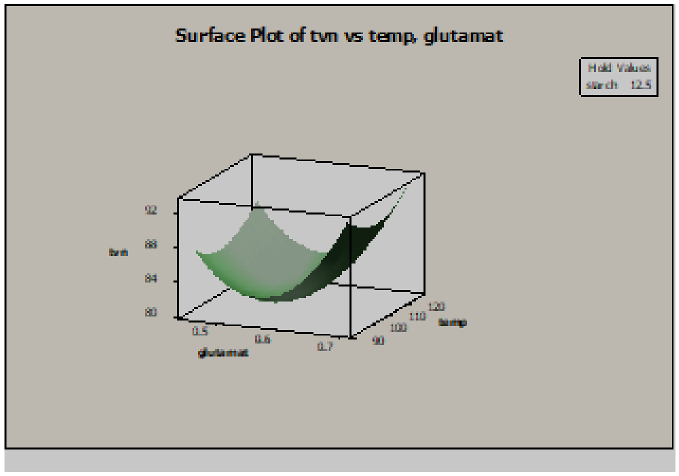

Figure (3): Mutual effects of glutamate concentrations and temperature on the TVBN in the third month at ambient temperature

Examining the response surface diagram of the simultaneous effect of glutamate and starch concentrations on peroxide index variations in the third month under ambient temperature

Figure (4) shows that as glutamate concentration increases, the peroxide level increases and also, as starch increases, the peroxide index first decreases and then increases. Regression coefficient results suggest that the effect of these two compounds on the peroxide index variations is significant at the level of 5%. Glutamate absorbs moisture to increase the peroxide index.

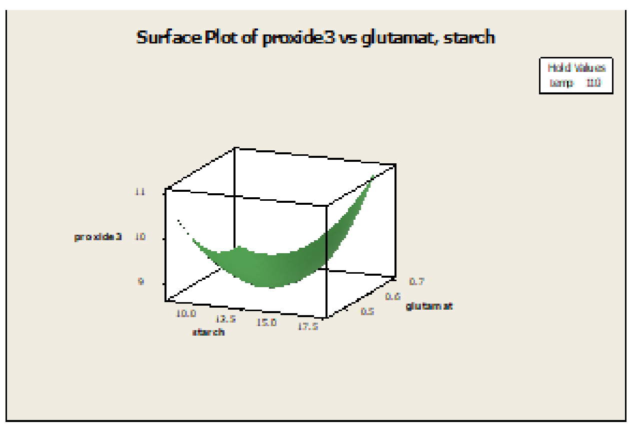

Figure (4): Mutual effects of glutamate and starch concentrations on peroxide index in the third month at ambient temperature

Examining the response surface diagram of the simultaneous effect of starch concentration and temperature on the peroxide index variations in the third month under ambient temperature

Figure (5) illustrates that as starch concentration increases, the peroxide level increases. Temperature also directly affects the level of peroxide, which, with the increased temperature, the level of peroxide increases. Regression coefficient results showed that the effect of these two factors on peroxide index variations is significant at the 1% level. Temperature degrades double bonds and creates free radicals to form hydroperoxide. Moisture trapped in the three-dimensional structure of the starch molecule increases the decomposition of unsaturated fatty acids and the production of peroxide compounds.

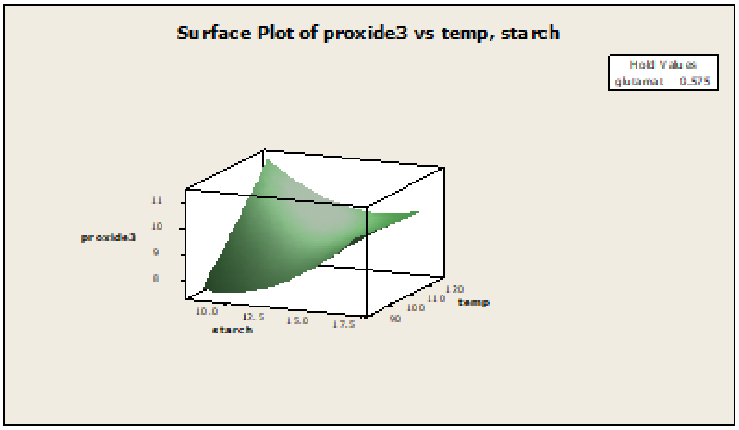

Figure (5): Mutual effects of temperature and starch concentrations on peroxide index in the third month at ambient temperature

Examining the response surface diagram of the simultaneous effect of glutamate concentration and temperature on peroxide index variations in the third month under ambient temperature

Figure (6) illustrates that as temperature increases, peroxide increases, but as glutamate concentration increases, the level of peroxide decreases. Regression coefficients show that the effect of these two compounds on the peroxide index variations is significant at the level of 1%. Glutamate was found to reduce the production of hydroperoxide. Since it lacks lipid composition, this compound cannot directly increase the index.

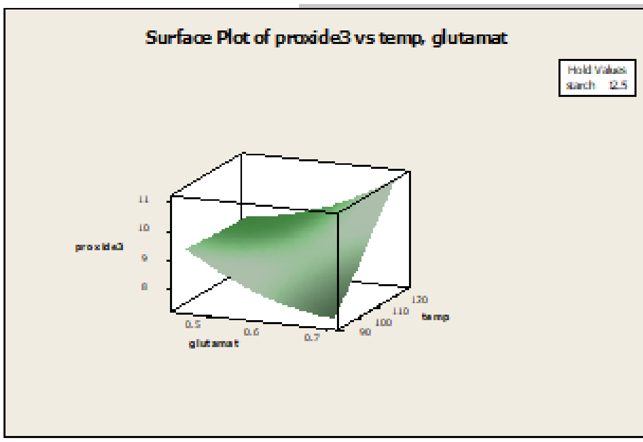

Figure (6): Mutual effects of temperature and glutamate concentrations on peroxide index in the third month at ambient temperature

Conclusion

The research found that various variables such as starch, glutamate and temperature had a significant effect on the chemical and sensory properties of meat samples. The examination of the effect of various concentrations of starch on the Total Volatile Basic Nitrogen (TVBN) determined their increasing effects on this index. Temperature also affects the TVB-N index, as when temperature increases, the breaking-down rate of peptide bonds increases, thus increasing the production of ammonia and volatile amino compounds. The TVB-N index was found to increase with increasing glutamate content. This suggests that sodium glutamate can increase amino compounds in meat samples. Also, a review of samples stored in the refrigerator and ambient temperatures determined that the TVB-N index decreases at refrigerator temperature due to reduced microorganism activities. Peroxide index results showed that as temperature increases, the level of peroxide compounds increases. This is due to the role of heat in breaking down the double bonds which contain high levels of fatty acids in meat tissue. Also, as starch content increased, the level of this index increased. One of the factors affecting oxidation is moisture, as starch and glutamate play an important role in absorbing the moisture of the product. As a result, as these two compounds increased, the peroxide index increased, also.

References

Parsapour, M. & Lameh, H. (2002). Possibility of producing potato chips by drying method.

Daraei-Garmakhani, A. Mirzaei, H. Maqsoodlou, Y. & Kashani Nejad, M. (2008). Examination of physicochemical properties of three potato types in Golestan province and its effect on the properties of semi-fried slices. Journal of Food Science and Technology. 8 (3): 49-56

Hassanzadeh, P., Tajik, H., & Razavi Rouhani, S. M., (2011). Application of oral coating of chitosan containing grape seed extract on the quality and shelf life of chicken meat in the refrigerator. Journal of Food Industry Research, 12(4)

Hosseini, F. Milani, A. & Blourian, Sh. (2011). The effect of microcrystalline cellulose as a fat substitute on physicochemical, textural and sensory properties of low-fat hamburgers. Journal of Food Industry Research. 21(3)

Daraei-Garmakhani, A.; Mirzaei, H.; Maqsoodlou, Y. & Kashani Nejad, M. (2008). Use of hydrocolloid substance as edible coatings to produce low-fat chips. Journal of Agricultural Sciences and Natural Resources

Choobkar, N.,; Akhondzadeh Basti, A., Soltani, M., Sari, A., Malekshahi, A., Nemati, Gh & Partovi, R., (2010). Review of Staphylococcus aureus bacteria growth in silver carp fillets processed with salt and nisin. Journal of Veterinary Research, 65: 193-198.

Safarpour Dehkordi, F., Yahaghi, A. & Khodavardi Darian, A. (2014). Prevalence of antibiotic resistance of Escherichia coli isolated from chicken meat supplied in Isfahan province, Iranian Journal of Medical Microbiology, 8 (2): 47-40.

Maghsoudlou, Y.; Asgharpour, A, & Aryaei, P. (2013). The effect of adding Khuzestani savory essence (Satureja khusestanica) on bacterial, chemical and sensory properties of Frankfurter sausage. Journal of Research and Innovation in Food Science and Technology 2(3): 279-294.

Al-Shuibi, A. M. & Al-Abdullah, B. M. 2002. Substitution of nitrite by sorbate and the effect on properties of mortadella. Meat Science, 62: 473-478.

Akkuş Ö, C Varlık, N Erkan and S Mol, 2004. Determination of some quality parameters of fishballs prepared from raw and boiled Fish. Turk J Vet Anim Sci, 28: 79-85.

AOAC, 2000. Official Methods of Analysis. 17th ed.Association Official Analytical Chemistry, Maryland, USA.

Biliaderis CG(1991): The structure and interactions of starch with food constituents. Canad J Physiolog Pharmacol69:60-78

Gram L, Huss H. H., 1996: Microbiological spoilage of fish and fish products. Food Microb, Vol, 33:121–37.

Fan, W., J. Sun, Y. Chen, J. Qiu, Y. Zhang, And Y. Chi. 2009. Effects of chitosan coating on quality and shelf life of silver carp during frozen storage, Journal of Food Chemistry. 115: 66-70.

Fan, W., Chi Y., and Zhang S. 2008. The use of a tea polyphenol dip to extend the shelf life of silver carp (*Hypophthalmicthys molitrix*) during storage in ice, Food Chemistry 108, 148–153
Sallam, M. Ishioroshi, K. Samejima. Antioxidant and antimicrobial effects of garlic in chicken sausage. Lebensm.-Wiss. U.-Technol. 37 (2004) 849–855.
Jayawardana, B., C, Hirano., T, Kyu-Ho Han, Ishii, H., Okada, T., Shibayama, S., Fukushima, M., Sekikawa, M., Shimada, K., I. 2011. Utilization of adzuki bean extract as a natural antioxidant in cured and uncured cooked pork sausages. Meat Science 89 (2011) 150–153.
Yaghmur, A., Aserin, A., Mizrahi, Y., Nerd, A., & Garti, N.2001. Evaluation of argan oil for deep-fat frying. LWT-Food Science and Technology, 34(3), 124-130.
Takeuchi.j. Nagashima.t (2011). Preparation of dried chips from Jerusalem artichoke (*Helianthus tuberosus*) tubers and analysis of their functional properties. Food chemistry 126:922-926
Zhang.l.barbute.s(2005) .effect of regular and modified starches on cooked pale, soft, and exudative, normal and dry, firm and dark breast meat batters.poultry science 84:789-796