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REVIEW OF LITERATURE OF SAUSAGES

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Abstract:

Sausages are globally cherished meat products with rich cultural, culinary, and nutritional significance. This literature review explores the legal, safety, and cultural dimensions of sausage production, with particular attention to food safety regulations and traditional sausage varieties. Emphasis is placed on the presence and control of polycyclic aromatic hydrocarbons (PAHs), recognized as carcinogenic contaminants, and the differing international regulatory frameworks addressing their levels in food products. A special focus is given to the traditional Northern Thai sausage, *Sai oua*, renowned for its distinctive herbal and spicy profile, along with its cultural significance and artisanal preparation methods. The review also addresses biological hazards in sausage production, highlighting common microbial, parasitic, and viral risks. The study underscores the importance of regulatory oversight, safe food handling practices, and cultural preservation in the evolving landscape of sausage production.

Keywords: Sausage Production, Food Safety, Polycyclic Aromatic Hydrocarbons (PAHs), Sai Oua, Traditional Sausages, Food Regulations, Microbial Contamination, Thailand, Smoked Meat, Cultural Food Practices

Introduction:

Sausages represent one of the oldest forms of processed meat, historically developed as a means to preserve meat and enhance its flavor through the use of spices, herbs, and smoking techniques. Today, sausages are not only culinary staples in many cultures but also subject to rigorous safety and regulatory scrutiny due to potential health risks associated with their production and consumption. Key among these concerns are contaminants such as polycyclic aromatic hydrocarbons (PAHs), which can form during smoking and grilling processes and are recognized for their carcinogenic potential.

Regulatory frameworks around the world—such as those enforced in the European Union, United States, China, and New Zealand—set maximum limits for PAH concentrations in food, particularly in smoked meats like sausages. These standards are crucial for protecting public health and ensuring food safety. Alongside regulatory measures, the production of traditional ethnic sausages, such as *Sai oua* from Northern Thailand, highlights the diversity and cultural richness of sausage-making practices. *Sai oua* exemplifies how regional ingredients and traditional methods contribute to unique flavor profiles and cultural identity.

This review aims to provide a comprehensive overview of sausage production regulations, health risks, and cultural practices. It highlights the need for balancing food safety and tradition, ensuring that consumers can enjoy these products without compromising health or heritage.

Literature review:

In New Zealand, food regulations related to sausage making are primarily governed by the Food Act 2014 and the Food Regulations 2015. These regulations outline the requirements for food safety, hygiene, labeling, and composition of sausages, among other food products. The New Zealand Ministry for Primary Industries (MPI) oversees and enforces these regulations to safeguard public health and maintain the integrity of the food industry. Under the Food Act 2014, all food businesses, including those involved in sausage making must ensure that the food they produce is safe and suitable for consumption. This includes maintaining hygienic practices during the production process, using safe ingredients, and preventing contamination. The Food Regulations 2015 provide more specific requirements for sausage making, including regulations on labeling and composition. For example, sausages must be labeled accurately to indicate ingredients, allergens, and nutritional information. Additionally, there are regulations regarding the composition of sausages, such as limits on the use of additives and preservatives. https://www.legislation.govt.nz/

Polycyclic aromatic hydrocarbons and their toxicity:

Organic molecules with two or more fused aromatic rings of carbon and hydrogen atoms are known as polycyclic aromatic hydrocarbons, or PAHs. Their dangerous carcinogenic and mutagenic potential makes them ubiquitous environmental contaminants (McGrath et al., 2007, Wegrzyn et al., 2006). In an overview published in December 2002, the scientific community on foods (SCF) offered a thorough analysis of the toxicity of PAHs in food. They designated BAP as a food-related PAH marker i.e., 5µg/kg maximum level for Smoked meat and its products, 2µg/kg for Oils and fats for human consumption according to EC no. 1881/year 2006 whereas, 2µg/kg for Smoked meat and smoked products according to Commission Regulation (EU) 835/August 2011.

Regulations on PAH concentration in foods, including Sausages:

Each nation or area has different laws governing the presence of polycyclic aromatic hydrocarbons, or PAHs, in food items like sausages. Here are a few instances of rules from various authorities:

European Union (EU): Maximum levels of benzo(a)pyrene (BaP) in smoked meat and smoked meat products, such as sausages, are specified by Regulation (EC) No 1881/2006 of the European Parliament and of the Council of December 19, 2006, setting maximum levels for certain contaminants in foodstuffs, as amended by Regulation (EU) 2015/1933. BaP in these goods is present at a maximum of 5µg/kg. Retrieved from European Union Law (European Commission, 2015)

United States: The Food and Drug Administration (FDA) in the United States does not have any particular rules regarding the amount of PAHs in sausages. However, under the Federal Food, Drug, and Cosmetic Act (FFDCA), the FDA may take action against food items discovered to contain dangerous amounts of pollutants, including PAHs. While the FDA establishes action limits for some pollutants found in food, PAHs are not one of those contaminants.

China: The People's Republic of China's National Standard GB 2715-2016, "Maximum Levels of Contaminants in Foods," establishes maximum limits for PAHs in a variety of food items, including sausages and other pork products. Both the overall PAH content and specific PAH component restrictions are outlined in the standard. China Food Safety Law (2015) and its implementing rules control the quality and safety of food in the country. (Liu, Q et al., 2023)

Germany: The German Food and Feed Code (LFGB) establish guidelines for the country's food safety. These rules comply with all EU criteria, including those pertaining to the amount of PAH in foods like sausages. The German Food and Feed Code (Lebensmittel- und Futtermittelgesetzbuch, LFGB), which complies with EU regulations, contains the pertinent rule. The regulations (EC) No 1881/2006 and Regulation (EU) 2015/1933 specify the maximum quantities of polycyclic aromatic hydrocarbons (PAHs) in smoked meat and smoked meat products, such as sausages. The maximum amounts of a particular PAH chemical called benzo(a)pyrene (BaP) in smoked meat and smoked meat products, such as sausages, are set out in this rule. Benzo (a) pyrene in these goods is present at a maximum level (5µg/kg). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32006R1881 or EC no. 1881/year 2006

Ethnic sausage type Sai oua from Asia and its uniqueness:

Sai oua

"Sai oua" stands out among sausages for its unique blend of aromatic herbs and spices, creating a distinctive flavor profile that reflects the culinary traditions of Northern Thailand. There are some factors with make it unique such as Ingredients, spicy heat, method of preparation and so on.

Aromatic Ingredients: Sai oua is characterized by the use of fresh and dried herbs, along with selected spices, which impart a complex and fragrant aroma to the sausage. Key ingredients include lemongrass, kaffir lime leaves, galangal, garlic, shallots, and cilantro. These ingredients are finely chopped or pounded into a paste, releasing their essential oils and flavors, which infuse the ground pork mixture. (Reid et al., 2010)

Spicy Heat: Dried red chilies are a crucial component of sai oua, providing not only heat but also depth of flavor. The level of spiciness can vary depending on personal preference and regional variations, but it is a defining

characteristic of this sausage. The combination of spicy chilies with aromatic herbs creates a harmonious balance of flavors that is both bold and nuanced. (Van Esterik and Penny, 2008)

Cooking Method: Traditionally, sai oua is grilled over charcoal or fried in a pan, allowing the flavors to intensify and the exterior to develop a crispy texture. The grilling or frying process infuses the sausage with a smoky aroma, complementing the herbal and spicy notes of the filling. This cooking method enhances the overall sensory experience of enjoying sai oua. (Pailin C., 2017)

Cultural Significance: Sai oua is not only a culinary delight but also a symbol of Northern Thai heritage and culture. It is often enjoyed during festivals, celebrations, and family gatherings, serving as a reminder of traditional culinary practices passed down through generations. Its popularity has also extended beyond Thailand, gaining recognition among food enthusiasts worldwide for its unique flavors and craftsmanship. (Kraig B., and Sen C. T., 2013)

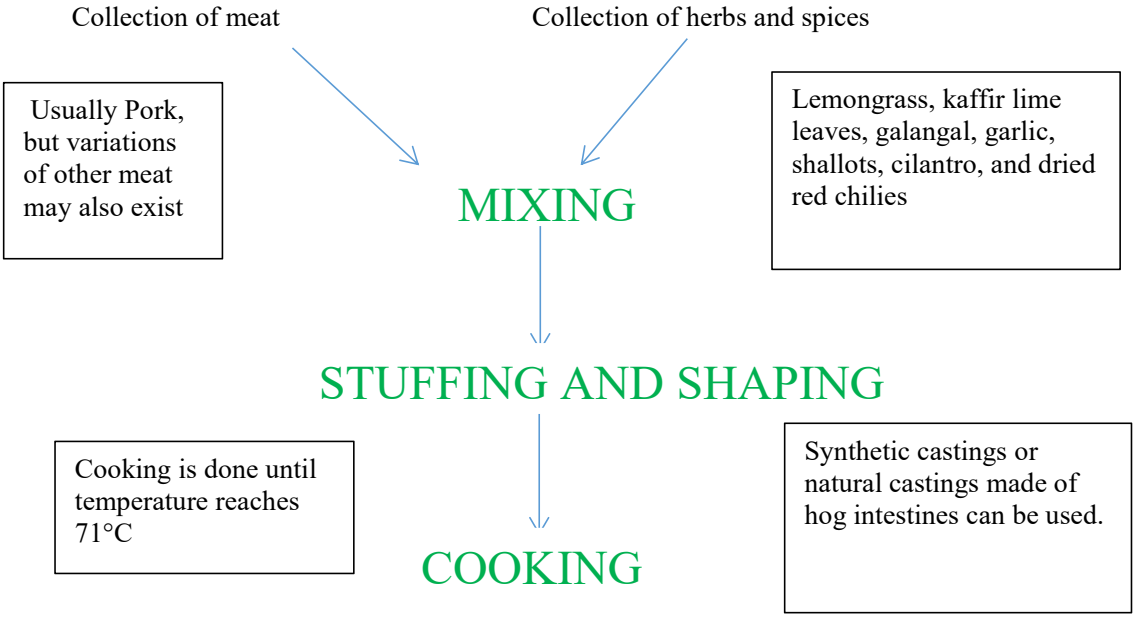

Figure: Process Flow diagram for making ethnic Sausage.

Process of making Sai oua:

1. Meat: Although there may be modifications using different meats, pig is usually the primary meat element in sai oua. To get a consistent texture, the meat is carefully crushed, commonly using a meat grinder (Condition: Ensure meat is fresh and Clean and sterile grinder should be used.) (Van Esterik and Penny, 2008)

2. Herbs & Spices with Aromas: Some of the main components used to flavor sai oua are lemongrass, kaffir lime leaves, galangal, garlic, shallots, cilantro, and dried red chilies. To unleash the flavors, these components are either finely minced or crushed into a paste (Condition: Ensure spices are fresh and have good aroma). (Van Esterik and Penny, 2008)

3. Mixing and Seasoning: The prepared herb and spice combination is mixed with the ground pork. To guarantee that the flavors are distributed evenly throughout the sausage, the mixture is well combined.

4. Stuffing and Shaping: The beef mixture that has been spiced is placed into casings. Although synthetic casings can also be utilized, natural casings produced from hog intestines are the norm. The sausages are fashioned into individual links once the casings are filled. This is often done by twisting or tying off the ends of each sausage to produce distinct parts (Condition: Casings must be clean and ensure for uniform size and shape for consistent cooking. (Pailin C., 2017)

5. Cooking: Usually, Sai oua sausages are grilled over charcoal or pan-fried. The sausages' exteriors turn crispy throughout the cooking process, which also melds the flavors together (Condition: Cook sausages until internal temperature reaches safe levels i.e., 160°F or 71°C). (Pailin C, 2017)

Biological hazards associated with production of Sausages:

Like any other meat product, sai oua sausage manufacturing may present some biological risks that need to be controlled to guarantee food safety. The possibility of infection by pathogenic microorganisms, such as bacteria, parasites, and viruses, is the main one of these threats. The following are some biological risks connected to the making of sai oua sausage.

1. Contamination by Bacterial species:

Salmonella, Escherichia coli (E. coli), Listeria monocytogenes, and Clostridium perfringens are only a few examples of the bacteria that can be hazardous if they are present in raw meat or if they are introduced during processing (Jay J. M. et al., 2005).

2. Contamination by Parasite:

Pork that has not been cooked sufficiently may get contaminated by parasites such as Trichinella spiralis, which is the cause of trichinellosis. To completely remove the possibility of parasite infection, cooking must be done properly (Dupouy-Camet J., 2000).

3. Cross-Contamination:

If tools, surfaces, or utensils used in the manufacturing process are not thoroughly cleansed and sterilized, cross-contamination may happen. This may cause dangerous bacteria from raw meat to spread to adjacent surfaces or prepared goods (Williams, L., and Kornacki, J. L. 2013).

4. Toxin Formation:

If infected meat is not cooked to a temperature high enough to render the toxins inactive, toxic bacteria like Staphylococcus aureus can develop heat-stable toxins that can lead to foodborne sickness (Bergdoll, M. S., 2013).

5. Viral Contamination:

Pork may be contaminated by viruses like the Hepatitis E virus (HEV), which can be dangerous if eaten raw or undercooked. It's critical to follow safe handling and cooking procedures to lower the chance of virus infection (Meng X. J., 2010).

Conclusion:

The study of sausage production reveals a multifaceted interplay between culinary tradition, food safety, and regulatory governance. As seen through the lens of international regulations, the management of contaminants such as polycyclic aromatic hydrocarbons (PAHs) remains a critical concern, particularly in smoked meat products. Diverse global standards emphasize the universal importance of safeguarding public health while respecting regional practices.

Traditional ethnic sausages like *Sai oua* demonstrate the cultural value embedded in food practices, showcasing unique ingredient profiles and preparation methods that contribute to culinary diversity. However, such artisanal products must also contend with biological hazards—ranging from bacterial contamination to viral and parasitic threats—necessitating strict hygiene and proper cooking procedures.

Moving forward, integrating scientific rigor with cultural appreciation will be essential in promoting safe yet authentic sausage products. Strengthened food safety systems, educational outreach, and technological innovations can help bridge traditional craftsmanship with modern quality standards, fostering both public trust and cultural preservation.

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