

THE APPLICATION AND PROSPECT OF GREEN MANUFACTURING TECHNOLOGY IN MODERN PROCESSING OF TRADITIONAL MEAT PRODUCTS

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I. INTRODUCTION OF GREEN MANUFACTURING TECHNOLOGY OF MEAT

The traditional meat products have a long history of 3000 years in China and are famous for their unique color, aroma, taste and texture, which is an important part of the world's precious historical and cultural heritage. The most common processing methods are frying, grilling, smoking and boiling, which give the meat products pleasant flavor, attractive color and great texture. At the same time, some hazardous chemical substances are produced, which is a threat to both the environment and human health, such as polycyclic aromatic hydrocarbon (PAHs), heterocyclic aromatic amines (HAAs), trans fatty acids (TFAs), formaldehyde, cholesterol oxidation products (COPs) and PM_{2.5}, and so on[1-3].

The green manufacturing technology (GMT) belongs to the category of green chemistry, which was proposed two decades ago. The GMT of meat is defined as a modern manufacturing approach that basing on the concepts and principles of green chemistry and green engineering, turning high-quality raw meat into healthy meat products by green formula design, green processing, green packaging, green transporting and green selling so as to minimize the risks of hazardous chemicals to human body and the environment, through which both economic benefits and social benefits can be obtained and coordinated[4].

II. APPLICATION OF GREEN MANUFACTURING TECHNOLOGY IN TRADITIONAL MEAT PRODUCTS

Green manufacturing technology of meat, also called “Sifei” technique, includes non-fried technique, non-boiled technique, non-smoked technique and non-grilled technique. The “Sifei” technique is based on GMT, which is a modernization on traditional industries.

(1) *Non-fried technique*

Fried meat products are popular with consumers all over the world. However, recent research shows that a large number of carcinogenic and mutagenic substances are produced in meat products after high temperature frying. Non-fried technique mainly includes the preparation of flavor enhancer, pickling, thermal field drying processing technology and spraying flavor liquid and so on. Two stages, named drying and coloring stage consist of the main processing technique.

(2) *Non-boiled technique*

The sauce halogen meat product has a history of more than thousands of years and is a typical representative of traditional meat products in China. The safety of the traditional Laolu has attracted the attention of scholars and HAAs are the main hazardous substances which has been confirmed by several scholars. Non-boiled technique uses the salting and thermal field drying processing technology. The salting stage is according to the habits of consumers in different regions and different kinds and proportions of spices are selected to prepare the spices package. And then, the thermal field drying processing is performed to dry the meat products.

(3) *Non-smoked technique*

Smoked meat products refer to those processed by smoking the meat with volatile substances produced by incompletely wood burning. However, the traditional smoked meat products are also polluted by many harmful substances such as PAHs and formaldehyde and so on. The core of non-smoked technique is the development of the smoking fluid with no formaldehyde and no BaP. Combined with thermal field drying processing technology, the smoked meat products with no formaldehyde and no BaP are manufactured.

(4) Non-grilled technique

Grilled meat is popular around the world because of its unique flavor. The heating temperature is generally between 190°C~260°C and a series of physiological and biochemical reactions that occur at this temperature produce the characteristic roasting aroma and color. However, it can easily lead to the generation of the carcinogenic, teratogenic, mutagenic and other harmful substances such as HAAs, BaP and other PAHs. Non-grilled technique is based on the principle of orientation control on Maillard reaction. The raw meat is dried at 110°C~120°C in the thermal field and the mixture of aroma precursors and substrates in the raw meat produces a favorable color and unique flavor.

(5) Characteristics of green manufacturing meat products

Based on the green manufacturing technology, a series of green and healthy meat products were developed. Table1 lists the detailed comparisons between the two processing methods.

Table1 The comparison of harmful substances in meat products between GMT and traditional technology

Processing method	Products	Fried grilled	boiled	Processing temperature/°C	Index	BaP ^[5] /μg·kg ⁻¹	HAAs ^[2] /μg·kg ⁻¹	TFAs ^[2] /g·kg ⁻¹	PM2.5 ^[3] /μg·m ⁻³
					Characteristics				
Traditional processing technology	Smoked fish	Yes	Yes	170-260	Oxidation flavor and poor chewing sense after high temperature sterilization.	1.30-15.2	20.89-108	53.46-130.96	1500-2500
GMT	Poultry	No	No	120-130	No oxidation and fried flavor, crisp taste after high temperature sterilization	0.11-0.32*	0.98-1.5	Not detected	100-200

*The content should not exceed 1.0 μg/kg in German standard, while the limitation content is 5.0 μg/kg in Chinese standard.

III. Prospect of Green Manufacturing Technology of Meat

In the 13th five-year plan for economic and social development of China, GMT will be fully implemented and the consumption will be guided toward to intelligence, green and health direction. Vigorously developing GMT has practical and historic significance in adjusting the industrial structure, eliminating outdated industrial capacity, promoting the upgrading of industrial technology, improving public nutrition and healthy condition and accelerating the pace of the ecological civilization construction, and so on.

IV. CONCLUSION

Nutrition, health and safety are important prerequisites for the healthy consumption of processed meat products. To reduce and eliminate the risk on the environment and health from traditional processing methods, the research and application of green manufacturing technology of meat products are attracting more and more attention.

ACKNOWLEDGEMENTS

This work was supported by the Herbivore Livestock fattening and Technique of High Quality Meat Produce Research of South China (Grant Number: 201303144).

REFERENCES

1. Djinic, J., Popovic, A., & Jira, W. (2008). Polycyclic aromatic hydrocarbons (PAHs) in different types of smoked meat products from Serbia. *Meat Science*, 80(2): 449-456.
2. Wang, Y., Hui, T., Zhang, Y. W., Liu, B., Wang, F. L., Li, J., & Peng, Z. Q. (2015). Effects of frying conditions on the formation of HCA and TFA in grass carp (*Ctenopharyngodon idellus*).. *Food Chemistry*, 167: 251-257.
3. Shi, J., Peng, Z., Zhu, Y., Wan, K., Yao, Y., Wang, Y., et al. (2013). Determination of PM2.5 concentration and hazardous substances in fumes from roast chicken production. *Meat Research*, 27(4): 36-39.
4. Peng, Z., Lu, H. (2013). Green manufacturing technology: A challenge and opportunity for the meat industry. *Food Science*, 34(7): 345-348.
5. Lu, H. (2015). Study on the volatile aromatic compounds of roast pork based on directional Maillard reaction and thermal field desiccant technology. (Master thesis). Nanjing agricultural University.