

# Development of a “Clear-Heat-and-Detoxify” Chicken Breast Prepared Dish Using Molecular Gastronomy

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**Abstract:** In this study, we combined the traditional Chinese medicinal formula “Wu Wei Xiao Du Yin” (Five-Ingredient Detoxification Decoction) with a low-temperature vacuum cooking approach from molecular gastronomy to develop a functional prepared chicken breast product with both “clear-heat-and-detoxify” efficacy and high-protein characteristics. The formula leverages the synergistic action of herbs such as *Lonicera japonica* (Jinyinhua), *Forsythia suspensa* (Lianqiao), *Houttuynia cordata* (Yuxingcao), *Taraxacum mongolicum* (Pugongying), and *Chrysanthemum indicum* (Yejuhua). The low-temperature vacuum cooking approach preserves heat-sensitive compounds in herbs by precisely controlling temperature and maintaining a vacuum environment. Thereby avoiding the degradation caused by high temperatures. This technique reduces the oxidation reaction of herbs and protecting oxidation-prone active ingredients. Additionally, prolonged low-temperature cooking ensures the gradual release of active compounds from the herbs. A series of experiments optimized temperature and cooking time, aiming to preserve nutrients, maintain herbal potency, and improve meat texture. Experimental analyses confirm that this product meets modern health-oriented and convenient consumption needs while helping to prevent common inflammatory diseases. This work underlines the value of integrating Traditional Chinese Medicine (TCM) theories with contemporary food processing techniques and has significant implications for expanding the repertoire of functional prepared foods and promoting “food as medicine” concepts.

## 1. Introduction

The increasing pace of modern life has driven the widespread acceptance of fast food and prepared meals, which provide convenience but often contain high salt and fat, contributing to various health issues [1]. At the same time, Traditional Chinese Medicine (TCM) stresses the concepts of “treating illness before it develops” and “food and medicine share the same origin,” advocating the integration of functional herbs into daily diets to maintain health [2]. Among many classic TCM formulas, Wu Wei Xiao Du Yin—consisting of *Lonicera japonica*, *Forsythia suspensa*, *Houttuynia cordata*, *Taraxacum mongolicum*, and *Chrysanthemum indicum*—effectively clears heat, detoxifies, and alleviates inflammatory conditions [2,5,7].

Chicken breast is widely favored for its high protein content, low fat, and digestibility, becoming a staple protein source in many countries [3,4]. However, most existing prepared chicken breast products are limited to simple cuts or basic marinades, lacking functional attributes to cater to consumers seeking both health benefits and palatable convenience. Molecular gastronomy, particularly the sous vide (low-temperature vacuum cooking) method, has emerged as a promising technology for preserving nutritional components and improving texture in meat products [6,9,10]. Sous vide provides precise thermal control in a vacuum-sealed

environment, effectively minimizing oxidation and water loss while enhancing flavor retention.

To address the demand for health-conscious prepared foods, this study integrates Wu Wei Xiao Du Yin herbal ingredients into chicken breast, processed using molecular gastronomy’s low-temperature vacuum cooking. By doing so, we aim to develop a product with “clear-heat-and-detoxify” properties, potentially useful in preventing inflammation-related ailments, while maintaining high-quality sensory attributes. This research highlights the possibility of merging TCM concepts with modern food science to broaden the functional prepared food market and advance the “food as medicine” principle.

## 2. Materials and Methods

### 2.1. Raw Materials and Major Equipment

#### 2.1.1 Raw Materials

- Chicken Breast: Fresh, boneless, skinless chicken breast with low fat and high protein.
- Chinese Herbs: Following Wu Wei Xiao Du Yin, key herbs include *Lonicera japonica* (20 g), *Forsythia suspensa* (15 g), *Houttuynia cordata* (15 g), *Taraxacum*

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*mongolicum* (15 g), and *Chrysanthemum indicum* (15 g) [2,7,8]. Additional herbal materials (e.g., *Platycodon grandiflorus*, *Mentha haplocalyx*, *Prunus armeniaca*, *Zingiber officinale*, *Scrophularia ningpoensis*, and *Rheum palmatum*) can be applied in sauces or coatings to reinforce the detoxifying effect [9].

- Seasonings: Salt, black pepper, five-spice powder, cooking wine, and soy sauce. Optional additions include sugar, vinegar, scallion oil, and peanut butter to balance herbal aromas.

### 2.1.2 Major Equipment

- Electronic Balance: Used for precise weighing of chicken breast, herbs, and seasonings [3,6].
- Vacuum Packaging Machine: Removes air before sealing to reduce oxidation and microbial growth [5,9].
- Low-Temperature Slow Cooking Machine: Maintains cooking temperatures between 55–65 °C under stable conditions [6,10].
- Others: Cutting board, knives, thermometer, timer, and filtering mesh for standard food preparation tasks.

## 2.2. Herbal Marinating Formula

### 2.2.1 “Wu Wei Xiao Du Yin” Marinade

Based on TCM literature [2,7,8], five primary herbs—*Lonicera japonica*, *Forsythia suspensa*, *Houttuynia cordata*, *Taraxacum mongolicum*, and *Chrysanthemum indicum*—were chosen to confer “clear-heat-and-detoxify” properties. Typical proportions are 20 g of *Lonicera japonica* and 15 g each of the other four herbs. The herbs are blended with salt (2–3 g per 100 g meat), soy sauce (10–15 mL per 100 g meat), black pepper (1–2 g per 100 g meat), and cooking wine (40 mL per 100 g meat). Sliced or gently pounded chicken breast is combined with this mixture in a vacuum bag. After sealing, the marinated meat is stored at 4 °C for 20 minutes to allow herb infusion.

### 2.2.2 Coatings and Sauces

To accommodate different cooking methods (e.g., boiling, steaming, frying), complementary seasonings can be formulated. For instance, coating mixes (flour, starch, and five-spice powder) can incorporate powdered herbal ingredients like *Platycodon grandiflorus*, *Mentha haplocalyx*, *Scrophularia ningpoensis*, and *Rheum palmatum*, providing additional cooling and detoxifying effects when fried or pan-seared [9]. Herbal sauces can be prepared by simmering specific herbs (e.g., *Platycodon grandiflorus*, *Mentha haplocalyx*, *Prunus armeniaca*, *Zingiber officinale*) for ~40 minutes, filtering the decoction, and mixing it with sugar, salt, vinegar, or peanut butter for a layered herbal flavor.

## 2.3. Molecular Gastronomy-Based Sous Vide Cooking

Molecular gastronomy underscores precise control of

cooking parameters, including temperature and cooking duration [3,6]. In this research, the marinated chicken breast is vacuum-sealed a second time and placed in a thermostatic water bath at ~65 °C for 30–40 minutes. This temperature range, supported by preliminary trials, effectively retains both nutritional and herbal bioactive components while achieving optimal tenderness and flavor [6,9,10]. Prolonged cooking times or higher temperatures may degrade the herbal efficacy and lead to dryness, whereas insufficient cooking time or temperatures below 60 °C risk incomplete pasteurization and residual off-odors [5,9].

## 2.4. Overall Research Flow and Experimental Design

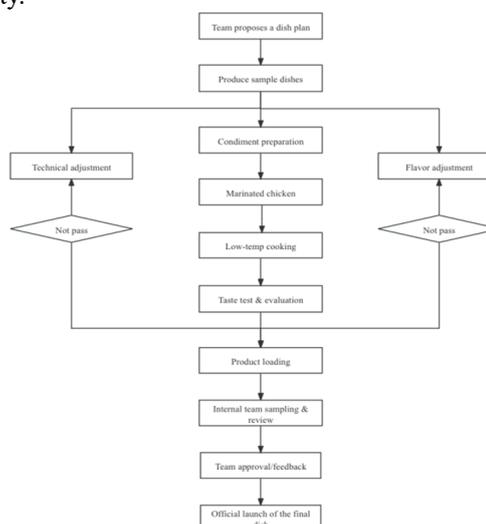
A systematic process was designed, consisting of:

1. Selecting raw materials and defining the functional objective: “clear-heat-and-detoxify” synergy with high-protein chicken;
2. Multiple iterations of marinade formulation and cooking parameter tests (temperature: 55, 60, 65, 70 °C; cooking time: 30, 40, 50 min);
3. Combining sensory evaluation (9-point scale: color, aroma, taste, tenderness, and overall acceptance), preliminary physicochemical measurements (moisture content, pH, protein retention), texture measurement and antioxidant activity determination;
4. Finalizing the optimum cooking protocol and evaluating potential for consumer acceptance [3,6].

## 3. Results

### 3.1. Overall Product Development Flow

Figure 1 displays the main procedure in developing this herbal chicken breast. It involves conceptual design, parameter optimization, iterative adjustments, sample evaluation, and final confirmation. The synergy of TCM principles with molecular gastronomy lays a foundation for both functional attributes and consistent product quality.



**Figure 1.** Overall Product Development Flow

As shown in Fig. 1, the team initially identified a recipe concept focusing on TCM-based anti-inflammatory potential. Subsequent trials were conducted to fine-tune marinade composition, cooking temperature, and duration, with unsatisfactory samples returning to the adjustment phase. When samples demonstrated favorable sensory and functional outcomes, the product prototype advanced to a more detailed evaluation stage.

### 3.2. Performance Under Different Low-Temperature Vacuum Conditions

Figure 2 shows a comparative analysis of various sous vide temperatures and times in terms of chicken breast sensory attributes and moisture retention. Temperature above 70 °C or cooking times beyond 50 minutes often resulted in a drier texture and partial loss of herbal bioactive compounds. Conversely, cooking below 60 °C or for less than 30 minutes left noticeable off-odors and raised microbiological safety concerns.

Entry	Temperature (°C)	Cooking Time (min)	Tenderness	De-odorization	Acceptable as a Precooked Product?
1	55	30	+	+	No
2	65	30	++++	++++	Yes
3	75	30	++	++++	No
4	85	30	+	++++	No
5	100	30	+	++++	No
6	55	40	++++	+++	No
7	65	40	++++	++++	Yes
8	75	40	+++	++++	No
9	85	40	++	++++	No
10	100	40	+	++++	No
11	55	50	-	++++	No
12	65	50	--	++++	No
13	75	50	--	++++	No
14	85	50	---	++++	No
15	100	50	----	++++	No

**Figure 2.** Effect of Various Sous Vide Conditions on Sensory Scores and De-odorization

As illustrated in Fig. 2, samples cooked at 65 °C for 30–40 minutes achieved higher composite scores in color, aroma, and tenderness. Measured pH values remained around 6.0–6.3, indicating good water retention. Protein levels showed minimal reduction. Additionally, the herbal decoction exhibited an intensified fragrance, presumably attributable to the vacuum-mediated “stewing” effect that promotes the release of active herbal constituents [9].

### 3.3. Study on the Effects of low-temperature vacuum cooking Method and Conventional Cooking Method on the Textural Properties of Products

Figure 3 illustrates the differences in textural properties (including chewiness, elasticity, and cohesiveness) of chicken breast treated by low-temperature vacuum cooking and conventional cooking methods, as measured by a texture analyzer at 65 °C, and provides a comparison between the two methods.

Measurement Index	Conventional Cooking Method	Low-temperature Vacuum Cooking Method
Chewiness(mJ)	12.5	19.7
Springiness(mm)	1.9	2.8
Cohesiveness(ratio)	0.45	0.63

**Figure 3.** The textural properties of chicken were measured under the two different cooking methods.

As illustrated in Figure 3, the experimental data indicate that the measured values for chewiness, elasticity, and cohesiveness of chicken breast cooked using the low-temperature vacuum cooking method are significantly higher than those of chicken breast prepared by conventional cooking methods. This demonstrates that low-temperature vacuum cooking outperforms conventional methods in these three aspects. By ensuring uniform heating and moisture retention, low-temperature vacuum cooking enhances the textural properties, resulting in a more tender and juicy texture of the chicken.

### 3.4. Determination and Comparison of Antioxidant Capacity under Different Conditions

Figure 4 illustrates the antioxidant capacity of the product, as determined by the DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging method under various conditions. The experiment divided the samples into four groups: Group 1 (low-temperature vacuum cooking with added Chinese herbs), Group 2 (conventional cooking with added Chinese herbs), Group 3 (low-temperature vacuum cooking without added Chinese herbs), and Group 4 (conventional cooking without added Chinese herbs).

Experimental Group	DPPH Free Radical Scavenging Rate(%)
Group 1	78.5
Group 2	64.4
Group 3	49.7
Group 4	45.3

**Figure 4.** Free Radical Scavenging Rate of Products under Different Conditions

As illustrated in Figure 4, the two groups of samples with added Chinese herbs (low-temperature vacuum cooking and conventional cooking) both exhibited significantly higher free radical scavenging rates compared to the groups without Chinese herbs. This indicates that the active components in Chinese herbs, such as flavonoids, phenolic acids, and polysaccharides, possess notable antioxidant properties. Additionally, under both conditions—with and without Chinese herbs—the low-temperature vacuum cooking group demonstrated a higher free radical scavenging rate than the conventional cooking group. The low-temperature vacuum cooking technique, through uniform heating and moisture retention, maximizes the preservation of active components in both the Chinese herbs and chicken, thereby enhancing antioxidant performance. In contrast, the conventional cooking group, potentially due to high temperatures causing partial degradation of active components, showed a lower free radical scavenging rate. Furthermore, according to the experimental data, the low-temperature vacuum cooking group with added Chinese herbs achieved the highest free radical scavenging rate (78.5%), suggesting a synergistic effect between the Chinese herbs and the low-temperature vacuum cooking technology. This synergy enhances the product's antioxidant activity and highlights its functional characteristic of "clear-heat-and-detoxify".

## 4. Discussion

### 4.1. Innovation in Process and Formula

Most conventional chicken breast products lack functional claims and rely on basic marinades. By contrast, **Wu Wei Xiao Du Yin** is widely used in TCM to treat heat-toxin syndromes (e.g., acute inflammations, abscesses) [2,7,8]. Merging it with low-temperature vacuum cooking improved the synergy of herbal actives and meat flavor. Thus, the final product exhibits both high-protein and “clear-heat-and-detoxify” features, enriching current prepared food lines [3,4]. This innovation exemplifies how TCM wisdom can be modernized via molecular gastronomy for contemporary consumers.

### 4.2. Market Feasibility and Consumer Acceptance

This product has good market feasibility. With the rise of healthy eating trends, consumers' demand for high-protein, low-fat, and functional foods is growing. Chicken breast, as a high-quality protein source, combined with the health benefits of herbal medicine, can meet consumers' dual needs for health and convenience. Sous-vide cooking technology maximizes the retention of nutrients and texture, enhancing product quality and aligning with the pursuit of convenient and healthy food in modern fast-paced lifestyles. The target market can be positioned at fitness enthusiasts, sub-healthy individuals, and middle-aged and elderly groups who focus on wellness, indicating significant market potential. However, consumers' acceptance of traditional Chinese medicine (TCM) flavors varies. Therefore, during product development, we have taken into account the influence of public acceptance of TCM flavors. The low-temperature vacuum cooking technology we use, compared to conventional cooking methods, can somewhat reduce the herbal flavor in chicken breast. Additionally, our product, after further processing by consumers, can also mitigate part of the herbal taste, increasing its acceptability.

### 4.3. Integration with Other Molecular Gastronomy Techniques

In addition to sous vide, molecular gastronomy includes techniques such as spherification, gelation, and foaming [9,11]. Batu [12] has characterized molecular gastronomy as a revolutionary approach in modern food production, stressing the synergy between advanced science and culinary creativity. Likewise, Davide [13] highlighted the scientific basis of cooking in the era of molecular cuisine, where biochemical principles intertwine with culinary artistry to generate innovative gastronomic experiences. For instance, fresh vegetables or seeds could be processed using spherification to create “bursting pearls” that retain nutrients while enhancing textural novelty. However, industrial adoption must consider production costs, raw material constraints, and shelf-life stability. Overly intricate processes may hinder widespread application despite potential culinary breakthroughs.

### 4.4. Limitations and Future Prospects

1. The current study primarily relies on laboratory-based experiments and limited consumer panels, requiring larger-scale trials and industrial pilot production for validation.

2. Although sous vide cooking effectively retains nutrients, the cost of vacuum packaging and cold-chain distribution may pose challenges.

3. Functional efficacy in preventing or relieving inflammatory conditions warrants more comprehensive clinical or in vivo experiments [6,9].

4. Further optimization of multi-herb synergy could harness advanced biochemical detection and molecular analysis, aiming to refine the proportion of each herb.

## 5. Conclusion

By integrating Wu Wei Xiao Du Yin with molecular gastronomy's sous vide technique (65 °C for 30–40 minutes), this research successfully developed a functional chicken breast product combining “clear-heat-and-detoxify” properties with substantial protein value. The product retained active herbal components while achieving enhanced tenderness and balanced flavor. Preliminary findings suggest its potential to assist in preventing inflammatory ailments and meeting modern demand for healthy, convenient foods. Additionally, the approach underscores the broader feasibility of merging TCM insights with state-of-the-art food processing, thereby offering new possibilities for the prepared foods sector and rural economic development. Further efforts should delve into industrial-scale validation, cold-chain logistics, shelf-life stability, and comprehensive clinical evaluations to firmly establish this product's role in enhancing human health.

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