EXPLORING THE NEW KITCHEN LAYOUT IN CHINA BY ANALYZING THE COOKING ROUTE AND CUISINE CULTURE

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Abstract: The modern Chinese kitchen evolved from the modern kitchen in Europe and the United States. The traditional research on the kitchen cooking route started in the United States and mainly focused on the cooking route and the kitchen working triangle. With the integration of Western and Chinese cultures and with the fast-paced lifestyle, Chinese tend to prefer a higher working efficiency of their kitchens. Thus, the traditional kitchen utensils can no longer satisfy their requirements. With the popularity of the kitchen system in kitchen design and the development of smart kitchen furniture, the present kitchen design method cannot meet the demands of modernization in practice. Due to the Chinese special dietary habits, the users often encounter some problems such as the low efficiency of cooking, insufficient food storage and the lack of preparation areas. This paper was designed to review the evolution of the Chinese kitchen from two aspects: the cuisine culture and the cooking route, to explore the basic situations of the modern Chinese kitchen, and to find a higher efficient kitchen work pattern by rearranging the Chinese kitchen layout, thereby providing references to the design of the Chinese kitchen in the future that how the Chinese kitchen layout can adapt to intelligent kitchen furniture.

Keywords: User Behavior, Kitchen Layout, Cuisine Culture, Cooking Route

1. Introduction

The change of Chinese domestic kitchen is from closed to open, which depends on two factors: one is the development of productive forces; the other is the local natural conditions and the people’s living habits. The founding of the state serves as a demarcation point in the development of the kitchen layout. Before the founding of the People’s Republic of China, the Chinese kitchen was perfected by the abundance of food sources and the evolution of cooking utensils. After the founding, the development of the kitchen was mainly influenced by the changes in policies and productivity. Through the evolution in different periods, the kitchen has gradually become scientific and reasonable. The modern kitchen layout is mainly characterized by the setting of the facilities based on the cooking process, so that users can cook according to the departments, reducing the repetitive work. Overall consideration should be given to the facility dimensions and coordination to enhance the reasonable mobility in the cooking space. Reasonable arrangement of storage space is adopted to improve the indoor health status, so that the kitchen space can get a maximum reasonable utilization.

This paper proposes to find out the factors that affect the development of the kitchen layout by reviewing the history of the Chinese kitchen. We collected Chinese domestic kitchen layouts based on the affecting factors to understand Chinese kitchen situation. So that the reasonability of the cases from the cooking route and the cuisine culture was analyzed and the problems of the modern Chinese kitchen were found. Finally, an assumption that the new Chinese kitchen layout can be equipped with future kitchen furniture was given based on the tendency of the kitchen.

2. Review of the History of the Chinese Kitchen
2.1. Ancient Chinese Kitchen

About 6000-7000 years ago, a fireplace was invented in the Neolithic period, in the prototype of which a ceramic cauldron and taolulian were formed. Generally located in the middle of the room or far away from the center of the room [1]. To exhaust gases produced by the stove and achieve easy operation, the stove was gradually moved from the center of the room to the corner, thus forming the kitchen function. At that time the kitchen is not separated from the ordinary house. In the Shang dynasty, a special kitchen function. At that time the kitchen is not separated from the ordinary house. In the Shang dynasty, a special kitchen appeared in the palace. The materials of cooking tools were also improved using the bronze cooking utensils, which symbolized the beginning of the division of the kitchen function areas [2]. As Su Jan Lee said in The Fine Art of Chinese Cooking, “The Chinese kitchen served as more than a kitchen: it was a laboratory, a factory, a marvel of efficiency”, which means in the Han dynasty, the division of labors was employed to enhance the kitchen work efficiency inside by developing the kitchen layout and cooking tools [3].

The era of the Wei, Jin and Southern and Northern dynasties was an important transitional period in the history of the Chinese kitchen. The cultural blending of the war cultures diversified China’s food sources and cooking methods, which promoted the development of kitchen cooking utensils [4]. At present, the traditional kitchen in China follows the design in the Ming and Qing dynasties, mainly with a stove, a processing table, utensils as well as food and water storage areas.

Z.C. Chang referred to in the Food in Chinese Culture that features of Chinese food culture involved the ecological environment, cooking methods, ideas and belief associated with food, as well as the substance and symbolism of food in life [5]. Ancient Chinese believed in feng-shui, by which the construction of the Chinese kitchen was similarly affected (restricted to wealthy families). As for the orientation of the kitchen door and hearth, people paid attention to its potential, not from the practical point of view [6]. At that time, the kitchen in the residential construction was built only to meet the needs in daily life and to prepare sacrifice in a relatively humble way, and the optimization of the functional structure did not arouse any attention [7].

2.2. The Development of the Chinese Kitchens after the Founding of the People's Republic of China

With the popularization of science and culture, the kitchen in the residence has taken a prominent position, showing the characteristics of increasingly scientific modernization. In the early days of the founding of New China, the slow development of social economy resulted in limited construction of residential buildings. The residential standard was low and the size was small, which result in the condition where several households shared one kitchen to obtain more living space. The kitchen at that time mainly adopted a simple form with a stove and a sink [8].

In the mid-1980s, the national policies introduced the rules and regulations of the residential design that each residence should have a bedroom, a kitchen, a bathroom and the storage space. At that time, the independent kitchen began to gradually gain popularity. But it was only limited to the residential area, there was no progress in the kitchen layout [9].

Since the 1990s, housing has been becoming a commodity to market consumption, and people have begun to pay attention to the practical functions of housing. Thus, the kitchen layout began to develop in the diverse direction. In June 1998, the state announced the termination of the welfare branch and began to commercialize the residential properties in an all-round way [10].

At the beginning of the 21st century, people started to pursue the aesthetic taste of the kitchen decoration based on satisfying the kitchen functions, and thus the concept of the integral kitchen cabinet appeared [11]. After 2003, people pursued the time efficiency. The new style of life with western meals led to the emergence of the double-kitchen design in some villas where the kitchen was divided into two spaces: the Chinese kitchen and the western kitchen [12]. The government also put forward the standardized kitchen form, the printing fundamental parameters for the kitchen and related equipment in housing, so that kitchen facilities could be approved for production [13].

By reviewing the history of the Chinese kitchen, it can be found that kitchen utensils and the cuisine culture are the main constraints on the development of the Chinese kitchen. Until the introduction of the first European integral kitchen cabinet, the integral kitchen cabinet market in a modern sense came into being. Chinese kitchen design tends to be market-oriented [11]. The research on the modern Chinese kitchen turns to center on the family, and focuses on the use of the cooking route to improve work efficiency. The change of dietary also leads to the western kitchen design.

2.3. Modern Chinese Kitchen Design

The kitchen is the most frequently used space at home. In the era of the experience economy, the role of the kitchen has been transformed from a cooking space to a comprehensive living space. Under the fast-paced work and
living environments, it should be taken into consideration in the future kitchen design the ways to improve efficiency in the kitchen and make cooking more interesting to respond to the various choices of food. The kitchen in the future can move towards a healthy, communicative and integrated one.

In the American home economist Christine Frederick’s opinion, normal families combine the function of the kitchen with the function of communication instead of taking it as the area only for cooking. Then, she designed a kitchen working pattern for women to make them work more reasonable and scientific (Figure 1) [14]. The Austrian architect Margarete Schütte-Lihotzky got inspiration from Freserick’s efficient kitchen and created the Frankfurt kitchen, which is the sample of world kitchen design. Both designs introduced the concept of the working route for improving kitchen work efficiency. The research of ergonomics experts shows that the layouts of kitchens are generally designed in a triangle form that contains three main kinds of kitchen equipment, namely stoves, refrigerators and sinks. [15]. The basic steps of kitchen work process should according to one-way cooking route, so that the kitchen could be efficient.

There are six major forms of the Chinese kitchen (Figure 2) [16]. These kitchen layouts are designed by the work triangle from the cooking process: Storage(refrigerators) – Sink(washing) – Cooking(stove). The L-shaped kitchen, I-shaped kitchen and U-shaped kitchen are the most widely used, and the cooking routes produced in the I-shaped kitchen and the U-shaped kitchen are more like triangles. The kitchen island is added as an auxiliary cooking space, which can help to deal with more ingredients, but the cooking route will be more complex. The peninsula kitchen layout gives more surface area for storage or extra preparation. Cooks who work in the I-shaped kitchen have single and repeated linear motion. Therefore, the longer the wall in the kitchen is, the longer the cooking route is. U-shape seems to have a shorter and simpler cooking route.

Even though the urban architectures in China are getting better and better, the size and structure of the kitchen is limited by the building structure, water and electricity. In China, the random selection of commodities is taken for granted. The Chinese kitchen design is mainly dominated by the supplied cabinet and other products such as the countertop, the sink and kitchen appliances, the sale of which is different from that of full equipment in Japan [17]. Generally, the limiting conditions to kitchen design are regions and life, nations and cultures, house structures, dietary habits etc. The main points are the house structures and dietary habits. Influenced by both policy and the market, the Chinese designers take the Frankfurt kitchen as a design sample, hoping to keep up with world design development quickly. The populace aesthetics is also getting gradually close to the Western style. In fact, because of the Chinese rich cooking method and long-time preparation for ingredients, the kitchen design (especially the cooking route) of western countries is more or less unsuitable.

Researches on development histories of Chinese kitchens found that factors that influence kitchen development are always changing and are featured with time characteristics. However, the changes in food sources and the development of kitchen utensils have always been fundamental reasons to promote the development of kitchens (Table 1). In the early days of the founding of the People's Republic of China, the design of kitchens was restricted by both policies and the market and ignored eating habits and cooking demands of Chinese. At the same
time, cooking utensils become more and more intelligent while the design of kitchen layouts was always lagging and could not match with demands of intelligent electronic equipment. Kitchen utensils which were originally designed to improve the efficiency of kitchens, reduced the efficiency of the kitchen because they were restricted by the layout. Chinese modern kitchens are designed according to the concept of work route and work triangle which can meet requirements of the basic cooking process. However, its theoretical basis is cooking behaviors and people's cooking behaviors are affected by cuisine culture and cooking utensils. Therefore, before designing the Chinese kitchen layout, we should firstly re-analyze dietary habits and cooking habits of modern Chinese. In addition, we should analyze the current situations of Chinese family kitchens based on Chinese modern cuisine culture and cooking methods so as to put forward some suggestions for the future kitchen design.

3. Research on the Modern Chinese Kitchen
3.1. Chinese Daily Cooking Behaviors

The Chinese cuisine culture is vast and profound, long standing and well established. “Eating” is not only for living, but also for communication. Chinese cuisine has a set of process system (Figure 3). The process for making three meals a day is rather complicated which needs a variety of kitchen utensils, certain operation and storage space. As such kind of space, the kitchen must have a layout that conforms to Chinese dietary habits [18, 19]. The structure of traditional Chinese families used to be the three-generation family or the nuclear family. The one who cooked was usually the mother or the father. Therefore, the traditional Chinese cuisine served as the major method [20]. The preference of kitchen utensils and the kitchen layout was the traditional cabinet equipped with simple kitchen appliances, which matched with the “working triangle” in terms of the cooking route. However, since the post-1970s and post-1980s, with the growth of population, the westernized dietary habits and the fast-tempo lifestyle have made different demands for the kitchen [18]. People are likely to try various kitchen appliances and new kitchen utensils to reduce the difficulty of working and improve the efficiency of working in the kitchen. Affected by the daily work, these people usually use the kitchen for breakfast, dinner and vacations. Sometimes they order takeout or eat out. In normal days, the kitchen is a place for diet, so the cooking is simple and convenient. Skillful and fixable cooking behaviors are applied for the kitchen. When time is sufficient in vacations, using the kitchen to cook delicious food to share with others will be satisfied [21]. The kitchen cooking route of this group of people contains uncertainty and complexity. They often read recipes when cooking in the kitchen so that they can get lots of information, which also leads to the repeated and disordered cooking routes and reduces the kitchen working efficiency.

3.2. Study on the Modern Chinese Domestic Kitchen Layout

The modern kitchen layout is characterized by the setting of the facilities based on the order of operation, so that users can cook with the departments and reduce the repetitive work [21]. To improve the reasonable mobility of indoor space, reasonable arrangement of storage space should be made to improve the indoor health status, so that the kitchen space can achieve maximum reasonable utilization.

A survey has been carried out to find about the structures of 32 modern Chinese domestic kitchens built from 2002 to 2012 with the aim of finding the existing issues of modern Chinese domestic kitchens by analyzing their layouts. Patterns and layout of these kitchens are compared through taking photos of real Chinese kitchens and drawing layouts of them. The ultimate goal is to find
characteristics of modern Chinese kitchen design and features of their actual usage (Figure 4). From those

<table>
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<th>Typical Kitchen Layout</th>
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<th>Extra Work Line Caused By Shelves</th>
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<td>Peninsula Kitchen</td>
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Figure 4. The Real Chinese Family Kitchen Layouts

After the analysis of those kitchens’ layouts, we found that 2 of them were peninsula kitchen of 2.5-12 m². The number of the L-shaped kitchens was 12 with the sizes of 4.08-8.58 m². That of the U-shaped kitchens was 16 with the sizes of 3.15-8.84 m². There were 1 L-shaped kitchens with the sizes of 2.5-5.6 m².

After the analysis of those kitchens’ layouts, there was an interesting phenomenon that users preferred using shelves and refrigerators to change I and L shapes into the U shape, while Island kitchen and peninsula kitchen remained unchanged (Figure 5). From those layouts, we also found the owners of L-shaped kitchen prefer to use some furniture like a moveable shelf or countertop for storage. The work triangle of the L-shaped kitchen changes to have an extra line. As the peninsula kitchen layout, it has a fixed counter for storage or cutting, and has an extra line.

Both the L-shaped kitchen and peninsula kitchen are similar with U-shaped kitchen (Figure 6). The difference of the three kitchen layouts is the position of refrigerator. It seems that the U-shaped kitchen has the higher work efficiency for the Chinese people with one-way work route. The users used the U-shaped kitchen to store as many ingredients and utensils as possible, so that they are unnecessary to leave the kitchen and bear the more extended and repeated cooking route. Those shelves were usually used to place kitchen utensils and ingredients, which could help users to easily realize their conditions and take them away. In terms of the ways of using shelves and refrigerators and the positions where users placed them, it was found that the users changed the kitchens’ layouts for the lack of storage space and the countertop. There was more space in the L-shaped kitchen, and thus users were used to adding other things. The Island kitchen and peninsula kitchen usually connected with the dining room; therefore, the dining room became the outstretched space of the kitchen with the
The kitchen layout was redesigned to be U-shaped by users themselves (Figure 7). Users changed their kitchen layout to satisfy their cooking experiment, and the cooking route of the kitchen was designed in flow based on the cooking process. According to the Chinese dietary habits, the kitchen forms three complex and repeated cooking routes centered with refrigerators. They are Refrigerator-Stove, Refrigerator-Stove, and Refrigerator-Shelf (storage area)-Sink-Cabinet-Stove-Table. The existing problems are found thereby as follows: (1) The kitchen space is not enough so that it will occupy other space; (2) The kitchen has very few functions, only with some basic kitchen appliances such as the sink, the stove, the countertop and the cabinet; (3) The range of activities is limited. The limited kitchen space causes that user can only do cooking in the kitchen. In the circumstance of the shortage of kitchen space, users tend to put some kitchen appliances and ingredients in the dining room. And then, users walk back and forth between the kitchen and the dining room, which leads to lower work efficiency. A new kitchen layout should be designed to conform to modern kitchen cooking habits. Users who put the frequently used kitchen utensils and ingredients within the range of their vision prefer the U-shaped kitchen which improves working efficiency and provides more storage space. It can be clearly seen that users need flexible and visual operation space.

3.3. The Future of The Chinese Kitchen Design

From the research of the Chinese kitchen layout, it could be found that all kitchen layouts were designed with the principle of the working triangle. However, this arrangement did not bring any convenience to users in the actual cooking process. On the contrary, users are used to modifying the kitchens’ structures based on their habits. For example, they would buy a movable shelf or store the food on the back of the door to make the preparation more convenient, improve the work efficiency in the kitchen and make it more suitable for personal working habits. The reason is that the information of the cooking process and ingredients is complicated and unclear and users need to handle all the information in the kitchen to get a sense of safety. It is apparent that the enclosed kitchen with the single function does not match the modern kitchen design. More functions should be come out. Arranging the kitchen layout based on the commands of users cannot fulfill the individual needs of the modern kitchen. Therefore, the concept that kitchen design should be based on the information of the kitchen and the personal working habits is a new design concept.

4. Conclusion

Thinking of Chinese future kitchen layout, the future kitchen must be an intelligent kitchen system [22]. The intelligent tendency contains intelligent kitchen appliances and cabinets. Nowadays, the kitchen appliance companies pay more attention to enhance the functions of kitchen appliances to improve work. At this point, the human cooking route changes with the different kitchen utensils and cooking methods. The design of the kitchen layout needs to consider the changes in new kitchen utensils and new kitchen functions.

The new kitchen layout method was proposed based on the conclusion of the Chinese dietary habits, the cooking route and the principle of efficient kitchens (Figure 8).
efficient kitchen should have a one-way cooking route. Users enjoying the new kitchen layout could follow the route of “Refrigerator-Sink-Countertop for Preparing-Storage Area-Cooking Area” to cook. According to the research of the Chinese housing kitchen layout, it was found that the Chinese people prefer the U-shaped kitchen and hope for some space to store ingredients. Then, a flexible space is designed for temporary storage. As the modern Chinese tend to follow the westernized dietary pattern, they need more reasonable storage space to keep more kitchen utensils. Fast-paced lifestyle and different sources of dietary information require larger countertops to put smart devices like tablet PC, so that we extend the space of countertops for placing those devices and kitchen appliances. Thus, suggestions are given of the new kitchen layout design principle, (1) The U shape should be kept to earn more storage space for kitchen utensils and ingredients; (2) There should be plenty of distances between the sink and the stove to prepare the ingredients and put kitchen appliances, thereby improving the efficiency of cooking. Modern kitchen cooking habits require new kitchen function areas. Therefore, the new kitchen layout should be designed to satisfy different cooking requirements and optimize the work experiment. In the kitchen design, it is a basic approach to arrange operation in the kitchen and guarantee the work efficiency and healthy diet by designing the kitchen layout. The future research will focus on how to provide more comfortable workflow in limited kitchen space, and how to design more reasonable cooking routes and layouts by analyzing user cooking behaviors. Kitchen design should stand on the basic functions and lifestyles to make cooking be an interesting thing. What should we do next is to verify whether the new Chinese kitchen layout design method can improve the efficiency of kitchens.

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