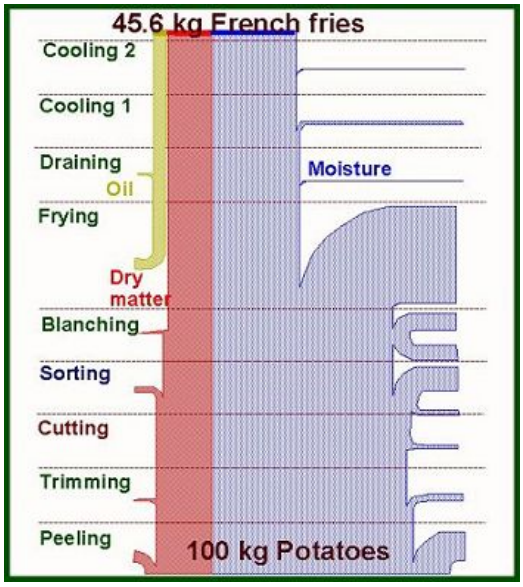
The Optimization of Frozen French Fries Processing Technology

I. Study Background

Potatoes are an important agricultural product, which are planted in most countries all over the world. They can be processed into many potato products, such as potato starch and potato starch products, potato chips, frozen french fries and so on. In recent years, with the rapid development of Western fast-food industry, French fries have become an essential food and its demand increases day by day. In America, up to 44% of potatoes has been used to produce French fries. This text talks about the processes of French fries, including color protecting, pre-cooking, drying and pre-frying and there are some parameters of pre-treatment processing. After slicing, color protecting and pre-cooking, the raw materials are firstly dried at 60℃ for 5 min, and then dried again at 80~90℃ for 20min, then fried at 170~175℃ in oil for 35~40s. The moisture content of the finished product is 65%~70%, oil content is 4.8%~5.7%. But for commercial fries, besides these processing, it usually needs frozen storage and final frying. So it still needs to definite the influence of pre-treatment process parameters on the quality of final product , and further optimize the process parameters.



The process flow of French fries line usually includes material selection, cleaning, peeling, slicing, blanching, cooling, drying, pre-frying, frozen storage etc. Texture, color and oil content is the main quality parameters. High quality fries not only have attractive golden brown,crispy outer layer but maintain wet and soft inside with lower oil content and less amount of acrylamide formation.Besides variety of raw material, the process parameters of blanching, drying, frying, frozen and so on is also important factors that can effect the quality of French fries. Agblor described pre-drying and pre-frying. after Pre-drying at 70℃, drying for 11min when the temperature reached to 120℃, then pre-frying at 180℃for 1min, frozen at -20℃, packing and storing. Bunger and Morieira make surface modification of raw French fries. Such as impregnating with NaCl solution or surface coating, then drying and pre-frying, which can reduce water on the surface and form a gelatinized starch layer to reduce oil content and the frying time. But there are few studies on optimization of the process parameters. In the aim of producing high-quality French fries and providing a basis for the actual production, this text uses potato variety "Netherlands 15" as material to study the influence of drying temperature, dying time, and pre-frying time on the color, water content and oil content of the frozen French fries.

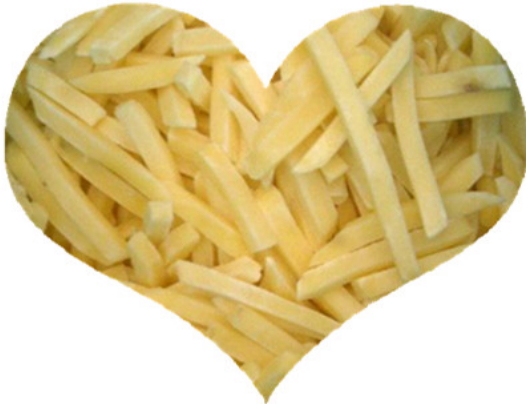
II. Material and Method

Experimental Material: potatoes, palm oil(food grade)

Instruments and Equipment: hot air circulation drying oven, automatic color difference meter, Ultra-low temperature freezer electric fryer

Experiment Method: selecting, cleaning, blanching for 2.5min in 95~100℃ boiling water, cooling rapidly in 1.5% glucose for 2min, then drying. after drying at the designed temperature and time, pre-frying in 180℃ palm oil(for the designed time), cooling and draining the oil on the surface, quick- frozen at -20℃, sealed, packaging and frozen. Fry the frozen French fries in 180℃ palm oil for 2min, cool, drain the oil on surface, put aside as frozen fries test sample.

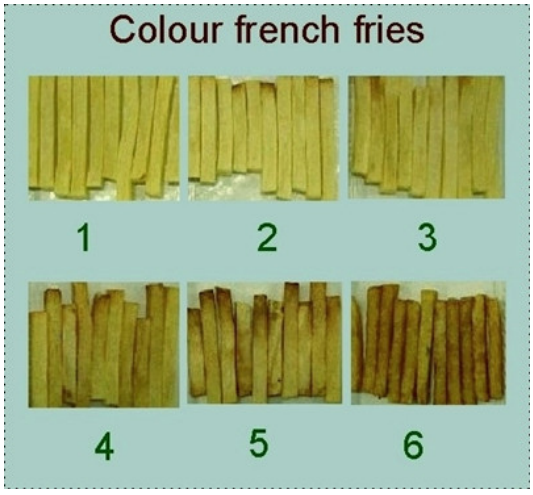
III. Results and Analysis



1. The Relationship Between Drying Temperature and Time With the Color, Water Content and Oil Content of French Fries.

When the pre-frying time is at average encoding value, the relationship between drying temperature and time with the color, water content and oil content of French fries is that when drying temperature and time are at -1~0 level of code value, the chromatic aberration is minimum. If the drying temperature is too high or too low and the drying time is too long or too short, the chromatic aberration will increase. The water content decreases as the drying time and temperature increase. Especially in high temperature area, as the drying time increases, the water content decreases obviously, and French fries loose too much water and become hard. Both low temperature and short time and high temperature and long time will lead high oil content , particularly obvious in high temperature and long time.

2.The Influence of Drying Time and Pre-frying Time on the Color, Water Content and Oil Content of French Fries.



The influence of drying time and pre-frying time on the color , water content and oil content of French fries is that when the drying temperature is too high or too low and the pre-frying time is too long, the chromatic aberration of the French fries will increase. When the drying temperature and the pre-frying time is at 1~2 level of encoding values, the water content of French fries reduce more. While the drying temperature and the pre-frying time is at 0-level encoding value or below, the oil content is low.

3. Results

The influence of drying time and pre-frying time on the color , water content and oil content of French fries shows that the color value increases obviously when the drying time is too short or too long. It increases slightly when the pre-frying time increases. When both the drying time and pre-frying time are short, the water content is high and the French fries are not up to crispy texture. When the drying time is too long and at the same time the pre-frying time is inadequate, the oil content is high.

4. Analysis

French fries is required to have an attractive blonde, a thickness of 1~2mm crispy outer layer, still remain wet and soft inside , low oil content and less amount of acrylamide in the quality characteristics. After a short time frying, the surface water of the French fries rapidly evaporates and the temperature raising leads to the Maillard reaction, making the product exterior color,crispy and scented. In order to reach this requirement, except suitable potatoes, making a reasonable process parameter is also needed. The study shows that the different operating conditions such as drying, pre-fring, may affect the quality of the final product. At the same condition of material, blanching, frozen etc, if the drying and pre-frying processes are different, the color, water content and oil content of the final product is different. After blanching fries processed, then the proper drying and pre-frying process, the water content will reduce and form a gelatinized starch skin. It is conductive to French fries to have Maillard reaction rapidly after short time frying and reduce the oil content of the final product and meet quality requirements of the product.

IV. Optimization of frying and pre-frying in the process of French fries

Because there was no loss effectiveness of factor, the tested factors have obvious influence on the color, water content and oil content of French fries and well fitting for the color, water content and oil content, the optimal conditions are gotten. They are 100℃, drying for 11~12min, pre-frying for 38s. The value of color difference is 3.99~4.45. The water content is 37.50%~38.50%. The oil content is 14.34%~14.85%. Each response variable simultaneously achieves the target value of commodity French fries.