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Salt alcohol additive pre-treatment to improve the performance of heat pump dried tilapia fillets

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Abstract

In order to obtain the effect of salt alcohol drying additive pretreatment on the drying performance of tilapia heat pump, three pre-treatment methods of propylene glycol, glyceryl alcohol and NaCl were used to pretreat the tilapia fillets. And the drying time, water activity, rehydration rate and Ca2 + -ATPase activity as the measurement index of a series of experiments, The change law of the drying curve, water activity, rehydration rate and Ca2+-ATPase activity were obtained. The results showed that the penetration dehydration effect of propylene glycol and glycerol is not as obvious as sodium chloride. These three increase Ca2+-ATPase activity at different levels. And they reduce the water activity of dried tilapia fish, and the capability of them: sodium chloride>glycerol>propylene glycol. Glycerol and propylene glycol can increase the rehydration rate while sodium chloride lessens it. Based on the results, the response surface analysis was used to optimize while the water activity and the Ca2 + -ATPase activity were taken as the response values. Investigating interaction between several pretreatment reagents, a combined pretreatment method was obtained: Propylene glycol 2% + glycerol 3% + NaCl 1%. Therefore, the appropriate pretreatment reagents and their combinations can be selected according to the concerns of the different quality indexes of the samples, and the conclusion can provide a reference for the drying pretreatment of similar products.

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Keywords: Tilapia Fillets; Heat pump drying; Pretreatment; Quality indicators

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1. Introduction

Tilapia, commonly known as African crucian, Nanyang crucian, has important edible value. Growing global tilapia production in recent years, China is the world's largest producer and exporter of Tilapia. In 2009, China's tilapia production was 1.257 million tons, and 47% of them from Guangdong Province [1]. Due to the delicious, tender, and rich in protein and various unsaturated fatty acids, more and more people prefer to eat tilapia. Currently, the tilapia and other aquatic product processing methods consist of drying and freezing processes. Freezing process technology requires a large initial investment, and higher costs of production and transportation. Drying processes have always been an important form of aquatic product processing. According to statistics, the world's total production of dried fish production is nearly 3.2 million tons per year [2,3].

At present, solar drying and air-drying are the two most commonly processing methods of drying fish. However, these processes have some problems, such as long drying time, product shrinkage, poor rehydration, loss of nutrition quality and high energy consumption [4]. Heat pump drying has a number of advantages, such as energy-savings, a closed loop drying system can be employed, good control of humidity can be achieved as well as control of air flow rate and good quality[5, 6]. This article reports on work on the use of different drying additives to preprocessed tilapia fillets, and pretreatment methods for tilapia drying using heat pumps.

2. Materials and Methods

2.1 Materials and Reagents

Tilapia: purchased in Xiashan seafood market, Zhanjiang city.
Reagents (AR): Propylene glycol, Glycerin, NaCl.

2.2 Instruments and Equipment

Heat pump drying system (developed in laboratory) [7]; UV spectrophotometer (Shimazu UV-1800); DZF-6050 series vacuum dryer (Shanghai Jinghong laboratory instrument co); JA 2003A series electronic analytical balance (Shanghai precision scientific instrument company); HD-4 intelligent water activity meter (Wuxi Huake instrument co, Ltd); HHS-electric constant temperature water bath (Shanghai Boxun industrial, Ltd).

2.3 Methods

2.3.1 Technological Process

Preparing raw fish - Preparing fish fillets - Pretreatment - Heat pump drying - Equilibrium (10h) - Tests and analyses

2.3.2 Operating Points

Preparing fish fillets: Fresh tilapia, removed head, tail, and disemboweling, scraped off the scales and got meat from the fish above the spine on each side, boneless, then peeled fish fillet sizes of 50 mm x 40 mm x 4 mm (± 1 mm), approximate weight 15 g.

Pretreatment: Impregnated fillets in solution of propylene glycol, glycerin, NaCl respectively, and the concentration of each solution has five levels, respectively, 1%, 2%, 3%, 4%, 5%, stirred once per hour, dipping 3 h. Set up a control group.

Heat pump drying: With blotting paper absorbed the fillets surface water, and put fish fillets neatly on the stainless steel net. Dried fish fillets to moisture content of 28%~30% in temperature 40°C, air velocity 2.5 m/s[7], under the condition of humidity 28% ~ 34%. Each experiment was repeated 3 times.

Response surface methodology (RSM): Selected the propylene glycol, glycerin, and NaCl by adding independent variable, surface dipping pretreatment, took the activity of AW and Ca2+-ATPase respectively for the response values,