



## Quality of Dried Gourami (*Osphronemus gouramy*) under Different Drying Methods

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### Abstract

Fish is an important source of high-quality protein essential for human consumption. Fish is a highly perishable foodstuff with a very short shelf life. Drying is a complex thermal process in which unsteady heat and moisture transfer occur simultaneously. The drying process effects on protein quality and composition of fish. Gourami (*Osphronemus gouramy*) has high nutrient content. However it has a short shelf life. It's necessary to remove its moisture content via drying. In our current study, the effect of different drying methods such as sun drying, microwave drying and oven drying to the quality of dried gourami (*Osphronemus gouramy*) was investigated. Results clearly revealed that microwave drying was the best selection to get a perfect dried fish quality for a long term storage.

**Keywords:** *Osphronemus gouramy*, Sun drying, Microwave drying, Oven drying, Water activity, Histamin, Aerobic plate count, Shelf life.

### Introduction

Seafood acts as a main component in the diet of most countries around the world. Fish is a highly perishable food; most fish tend to spoil within few hours after capture at tropical temperatures. After a fish dies, stiffening of the muscle called rigor mortis sets in and commences, due to the action of enzymes. Fish spoilage involves autolysis or self digestion, which means enzymes found in the body of the fish start breaking down the stomach walls and eventually the belly cavity [1]. Fish should be processed or preserves quickly [2]. Fish dehydration is important, because it can store fish by inactivating enzymes and eliminating moisture content necessary for bacterial and mould growth [3, 5].

A preparatory dry salting or brining stage usually precedes it and the stability of the end-product derives from the reduced water activity and, in some products, lowered pH [6]. Drying method has several effects on characteristics of flavor, color, and the nutritional value of the products [7]. Sun-drying is one of the most important low-cost methods of fish-preservation [8]. Sun drying still has many limitations. Sun drying can be improved considerably by raising the fish off the ground on wooden frames [9].

Microwave drying has been studied during the last two decades [10]. Microwaves work because of the quick absorption of energy by the water molecules, which causes rapid evaporation of the water and results in high drying rates for foods using less energy and giving a better quality of dried food (Kipcak, 2017). Electric oven for healthy eating recommended and this method is more suitable for long-term storage of dried fish [11, 16]. Gourami (*Osphronemus gouramy*) is a native fish in the family *Osphronemidae*. It has been cultivated by farmers due to high market demand, easy maintenance, stable price, high nutrient content and good taste [17, 18].

It is susceptible to damage or deterioration of quality. Many factors affect the quality deterioration of fish that includes internal factors that have more to do with the nature of the fish itself, and external factors related to the environment and human treatment. The present study focused on the effect of different drying methods such as sun drying, microwave drying and oven drying to drying of gourami (*Osphronemus gouramy*) fish.

### Materials and Method

#### Material

Gourami (*Osphronemus gouramy*) collected from Hau Giang province, Vietnam. They were taken fillets by sharp knife to get muscle out off their bone. The dried gourami (*Osphronemus gouramy*) production consisted of three main parts: salting, drying and storage. The salting process was supplemented with 3% salt, 1.5% sugar, 0.1% monosodium glutamate, 0.25% garlic extract, 0.25% minced pepper. Drying treatments were performed triplicate. All fishes used for drying were from the same batch. All dried fish would be packed in vacuum PA bag. Lab utensils were used including oven dryer, microwave dryer, High-performance liquid chromatography (HPLC), centrifugator, digital balance, glassware. Chemical substances were also used such as trichloroacetic acid, fluorophore standards, O-Phthaldialdehyde, standard histamine.

### Researching Procedure

#### Effect of Sun drying to Water Activity, Histamine, Aerobic Plate Count of Dried Fish

Gouramis (*Osphronemus gouramy*) after salting process were subjected to sun drying at average temperature 35°C on 4 consecutive days. Taking 100g of dried fish to analyze the water activity ( $a_w$ ), histamine (mg/kg), aerobic plate count (cfu/g). Based on the analyzing results, the optimal drying variable could be identified.

#### Effect of Microwave drying to Water Activity, Histamine, Aerobic Plate Count of Dried Fish

Gourami (*Osphronemus gouramy*) after salting process were subjected to microwave drying at different power and time settings (200 w in 90 minutes; 300 w in 75 minutes; 400 w in 60 minutes, and 500 w in 45 minutes). Taking 100g of dried fish to analyze the water activity ( $a_w$ ), histamine (mg/kg), aerobic plate count (cfu/g). Based on the analyzing results, the optimal drying variable could be identified.

#### Effect of Oven Drying to Water Activity, Histamine, Aerobic Plate Count of Dried Fish

Gouramis (*Osphronemus gouramy*) after salting process were subjected by oven drying at different temperature and time settings (44°C in 18 hours; 48°C in 16 hours; 52°C in 14 hours, and 56°C in 12 hours). Taking 100g of dried fish to analyze the water activity

( $a_w$ ), histamine (mg/kg), aerobic plate count (cfu/g). Based on the analyzing results, the optimal drying variable could be identified.

### Physico-chemical and Biological Analysis

Water activity ( $a_w$ ) was determined by water activity meter. Histamine (mg/kg) was determined by the method described in Jinadasa et al [19]. Aerobic Plate Count (APC, cfu/g) was measured by 3M-Petrifilm.

### Statistical Analysis

The experiments were run in triplicate with three different lots of samples. Data were subjected to analysis of variance (ANOVA) and mean comparison was carried out using Duncan's multiple range test (DMRT). Statistical analysis was performed by the Stat graphics Centurion XVI.

### Result & Discussion

#### Effect of Sun Drying to Water Activity, Histamine, Aerobic Plate Count of Dried Fish

Drying of fish is mainly carried out traditionally under sun light. The quality of dried fish is affected by the presence of microorganisms. Determination of microbiological quality of dried fish becomes very important when the consumer's health and hygiene is considered [20]. The water activity ( $a_w$ ) played an important factor in fish spoilage and the growth of different microorganisms depends on its rate [1]. Water activity helps limit or slow certain undesirable reactions, such as non-enzymatic browning, fat oxidation, vitamin degradation, enzymatic reactions, protein denaturation [21].

Histamine is a chemical compound found in spoiled scombroid fish and other marine fish contain high levels of histidine which is a free amino acid in the fish muscle [2]. Fresh fish was exposed in sunshine, often in tropical dry areas where moisture is low and the heat energy from the sun is extremely impressive, causes the during of loss of water from the fish before spoilage is reduced [22]. The major problem associated during the storage of sun-dried products is the fly infestation and contamination. The fish is contaminated by dust, dirt or sand and pathogens.

It is very slow process which makes the product unhygienic by contributing the

partial destruction of protein contents of the fish through oxidation and bacterial or enzymatic degradation. The physical and organoleptic qualities of most of the traditional sun-dried products available in the market are not satisfactory for human consumption [23]. In our present research,

gouramis (*Osphronemus gouramy*) after salting process were subjected to sun drying at average temperature 35°C on 4 consecutive days. Taking 100g of dried fish to analyze the water activity ( $a_w$ ), histamine (mg/kg), aerobic plate count (cfu/g). Results revealed in Table 1.

**Table 1: Effect of sun drying to water activity ( $a_w$ ), histamin (mg/kg), aerobic plate count (APC, cfu/g) of dried fish**

Sun drying (days)	Water activity ( $a_w$ )	Histamin (mg/kg)	APC (cfu/g)
1	0.78±0.03 <sup>a</sup>	0.52±0.03 <sup>b</sup>	5.5 x 10 <sup>6</sup> ±0.05 <sup>a</sup>
2	0.62±0.01 <sup>ab</sup>	0.57±0.02 <sup>ab</sup>	4.2 x 10 <sup>5</sup> ±0.03 <sup>b</sup>
3	0.45±0.04 <sup>ab</sup>	0.61±0.05 <sup>ab</sup>	7.2 x 10 <sup>4</sup> ±0.08 <sup>c</sup>
4	0.39±0.02 <sup>b</sup>	0.65±0.04 <sup>a</sup>	1.7 x 10 <sup>4</sup> ±0.02 <sup>d</sup>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ( $\alpha = 5\%$ )

Rozainee and Ng [24] examined the effectiveness of microwave power and hot air temperature on drying duration, dehydration behaviour, energy consumption and colour of dried catfish at microwave-hot air dryer, concluding that microwave assisted dehydration saving energy about 80-90% compared to convective hot air drying. Wu and Mao [25] demonstrated the effects of hot air drying and microwave drying on nutritional and odorous characteristics of grass carp fillets.

They found that the microwave treatment as an effective drying process for fish fillets. Hot air drying followed by microwave drying can decrease remarkably the drying time for drying fresh tilapia fillets compared with hot air drying [26]. A study was performed to investigate the influence of sun-drying treated with salt (30%) on the nutritive value (moisture, protein, fat, ash), chemical composition (TVB-N, FFA, pH) and bacteriological analysis (SPC, HBC) of two different size fresh water fish-species (*Channa punctatus* and *Mystus tengra*) [23].

**Effect of Microwave drying to Water Activity, Histamine, Aerobic Plate Count of Dried Fish**

The moisture content of the material was very high during the initial phase of the drying which resulted in a higher absorption of microwave power and higher drying rates due to the higher moisture diffusion. As the drying progressed, the loss of moisture in the product caused a decrease in the absorption of microwave power and resulted in a fall in the drying rate [26].

Microwave drying is cost-efficient, controlled, rapid and safe when used properly [27]. In our present research, gourami (*Osphronemus gouramy*) after salting process were subjected to microwave drying at different power and time settings (200 w in 90 minutes; 300 w in 75 minutes; 400 w in 60 minutes, and 500 w in 45 minutes). Taking 100g of dried fish to analyze the water activity ( $a_w$ ), histamine (mg/kg), aerobic plate count (cfu/g). Results were noted in Table 2.

**Table 2: Effect of microwave drying to water activity, histamine, aerobic plate count of dried fish**

Microwave drying	Water activity ( $a_w$ )	Histamin (mg/kg)	APC (cfu/g)
200 w, 90 minutes	0.40±0.03 <sup>ab</sup>	0.43±0.01 <sup>a</sup>	1.4 x 10 <sup>1</sup> ±0.05 <sup>a</sup>
300 w, 75 minutes	0.41±0.01 <sup>a</sup>	0.41±0.00 <sup>ab</sup>	1.1 x 10 <sup>1</sup> ±0.02 <sup>ab</sup>
400 w, 60 minutes	0.41±0.04 <sup>a</sup>	0.38±0.02 <sup>b</sup>	0.6 x 10 <sup>1</sup> ±0.06 <sup>b</sup>
500 w, 45 minutes	0.39±0.00 <sup>b</sup>	0.27±0.03 <sup>c</sup>	0.9 x 10 <sup>1</sup> ±0.03 <sup>ab</sup>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ( $\alpha = 5\%$ )

Rainbow trout (*Oncorhynchus mykiss*) fillets were subjected to microwave and infrared drying. For microwave drying, four different microwave power levels of 90, 180, 270 and 360 W were used, while for infrared drying,

three different infrared power levels of 83, 104 and 125 W were used [28].

**Effect of Oven Drying to Water Activity, Histamine, Aerobic Plate Count of Dried Fish**

Gouramis (*Osphronemus gouramy*) after salting process were subjected by oven drying at different temperature and time settings (44°C in 18 hours; 48°C in 16 hours; 52°C in

14 hours, and 56°C in 12 hours). Taking 100g of dried fish to analyze the water activity ( $a_w$ ), histamine (mg/kg), aerobic plate count (cfu/g). Results were noted in Table 3.

**Table 3: Effect of oven drying to water activity, histamine, aerobic plate count of dried fish**

Oven drying	Water activity ( $a_w$ )	Histamin (mg/kg)	APC (cfu/g)
44°C, 18 hours	0.43±0.04 <sup>a</sup>	0.48±0.01 <sup>a</sup>	3.9 x 10 <sup>5</sup> ±0.03 <sup>a</sup>
48°C, 16 hours	0.43±0.01 <sup>a</sup>	0.43±0.02 <sup>ab</sup>	2.7 x 10 <sup>5</sup> ±0.04 <sup>ab</sup>
52°C, 14 hours	0.42±0.02 <sup>a</sup>	0.41±0.01 <sup>ab</sup>	8.4 x 10 <sup>4</sup> ±0.02 <sup>ab</sup>
56°C, 12 hours	0.42±0.03 <sup>a</sup>	0.37±0.00 <sup>b</sup>	2.5 x 10 <sup>4</sup> ±0.05 <sup>b</sup>

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ( $\alpha = 5\%$ )

Convective drying is long and causes many undesirable changes in the fish. Mass transfer within the sample was more rapid during higher microwave power heating because more heat was generated within the sample creating a large vapour pressure difference between the centre and the surface of the product due to characteristic microwave volumetric heating [26].

*Govazim stranded tail, Hamoor and Zeminkan* hold in 70°C oven for 24 h until completely dried. The oven drying method had a good effect on decreasing drying time. The oven drying method is faster than the sunshine. The oven method is safer than the sun method [22].

### Conclusion

Dried fish is one of the traditionally preserved foods in Vietnam.

Drying is regarded as a traditional method of preservation of fish. Sun drying is most simple and economical method of fish preservation. Sun drying still has as long period of drying during cloudy climate, insect infestation and contamination from air borne dust.

Microwave drying times were much shorter than those for sun drying and oven drying. Gourami (*Osphronemus goramy*) is a freshwater species known for high economic value and nutritive contents. In our current research, microwave drying was demonstrated as the best option compared to sun drying and oven drying during the production of dried gourami (*Osphronemus goramy*) fish.

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