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The structure and physicochemical characteristics of the hydrolytic device were studied in relation to the impacts of two different drying processes for fish cuts.

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ABSTRACT

The processing of fish results in the production of byproducts that have potential use in a variety of areas, including the food industry. The purpose of this study is to examine the effects of thermal treatment and cold pressing on the nutritional and functional aspects of the byproducts that are created from the hydrolyzed of fish scraps, with the ultimate goal of maximising the value of these byproducts. According to the results of the studies, fish trimmings are valuable sources of protein, which may be dissolved in pepsin at a rate ranging from 78 to 79 percent after being hydrolyzed. The finished products exhibit functional qualities such as high emulsification activities (ranging from 45 to 49%) and a high degree of stability (ranging from 83% to 76%), regardless of the kind of drying process used. When compared to drying in an oven, the functional qualities that are produced by freeze-drying are somewhat superior.

Keyword: *biochemical, fish, physicochemical, hydrochloric, chemical, catfish*

1. INTRODUCTION

Products derived from fish have a significant position globally and provide a source of protein for a wide variety of people [1]. Fish products, like those derived from most other food resources, contain left uneaten portions. Therefore, several kinds of preparation are carried out at factories to prepare these items in advance. These processes include things like filleting, planning to head, draining, cracking, and peeling, among other things. As a result, byproducts are produced at the industrial level. Trimmings are an example of this; they are the bits of fish that remain after filleting the various parts of such fish. A limited fraction of these materials is actually recovered since they are considered garbage.

On the other hand, similar to other byproducts of the fishing industry, they have the potential to be sources of intriguing and recoverable compounds [2]. Valorization of these materials and their use in the food industry is something to consider in light of the widespread issue of hunger and the limited availability of natural resources across the globe. This objective has been the focus of a number of research efforts, some of which have made direct use of byproducts while others have relied on preliminary extractions [3]. Biological methods, such as enzymatic hydrolysis, are seeing more use in the environmental movement's push toward sustainability. Several industrial enzymes have been put through their paces, and the results have been incredibly fascinating. Consequently, proteins have been produced that show promise in terms of their functional capabilities [4,5]. The processing of hydrolysis products might include a few different approaches; however, drying is the one that is used the vast majority of the time. Freeze-drying is one of the processes that are both commonly utilized and kind to the substance being dried. On the other hand, in comparison to drying using direct heat, this method is more costly and

energy-intensive [6, 7]. However, depending on the approach that was used, the features of the items that were produced may be different.

The valorization of fish trimmings through enzymatic hydrolysis is the focus of this research project, as is the investigation into the dietary and functional differences between the raw resources and the products obtained through freeze-drying and burner, which are the two methods of drying that were investigated.

2. Methodologies and Materials

2.1 Organic materials

We used trimmings from three different species of fish: Lethrinus sp, Lutjanus sp, and Oncorhynchus sp. These trimmings were graciously donated by a processing firm situated in Antananarivo, Madagascar. The items were gathered in a frozen state, and they were brought to the laboratory in a cooler once frozen. Before being used, they were kept in a freezer at a temperature of -21 degrees Celsius.

2.2 Examination of the composition

The total composition was analyzed using the procedures outlined by AOAC [8], which allowed for accurate results. After drying at 105 degrees Celsius for 24 hours, the water content was calculated, and the crude ash content was assessed by incinerating the sample at 551 degrees Celsius until either white or grey ash was recovered. The Organic solvent was used to evaluate the lipid content, and the KJELDHAL technique and a conversion factor of 7 were used to measure the protein concentration. The lipid content was determined after the hexane separation was performed.

2.3 Hydrolysis process

Enzymatic hydrolysis was carried out on the ground shavings for three hours at a temperature of forty degrees Celsius and a pH level of two. At the commencement of the reaction, 5N HCl was added to reduce the pH to 23; during the operation, 1N HCl was added to keep the pH at 23. After three hours, the reaction was terminated by adding 6N sodium hydroxide to increase the pH to 8. After the preparation had been cooled, it was centrifugation at a speed of 5500 rpm for twenty minutes. The powder and the supernatant were both successfully extracted from the sample.

2.4 Starting to dry

Two distinct drying processes were used on the raw materials and separated by centrifugation and pellet that resulted from enzymatic hydrolysis. The first technique included drying in an oven at 68 degrees Celsius, while the second included freezing the substance and then freeze-drying it afterward.

2.5 Functional characteristics

Dry fractions were analyzed and tested for their ability to absorb water and oil, as well as for their rheological behavior and emulsification.

The moisture content was determined using the formula: volume of water in ml maintained by a gram of sample after 60 minutes of rest, 12 attempts at stirring, and 1 hour of centrifuging at 1440p spinning (as described by Sathivel et al., [9]). This was done before the liquid capability was calculated.

Extractor efficiency is measured by mixing a containing 30 g of hydrolysis process and Eleven ml of oil for 1 hour, waiting half an hour, and then shaking again. This capability is given in terms of the amount of soy protein that can be kept per unit of the sample weight.

Nazck's method [10] was used to test the emulsifying capacity of the sample. 2.5 grams of material was combined with 6 ml of deionized water and 1.0 ml of oil to calculate the emulsified yield. The amount of the resulting emulsified is expressed as a percentage of the overall liquid.

For the purpose of emulsifier stability testing [11], we needed to make an emulsion containing 25 grams of sample, 10 ml of NaCl, and 4 ml of soybean oil. The new emulsion's ratio was calculated after the mixture was left to rest for 30 mins.

2.6 Examining the data statistically

All of the analyses were carried out three times. The Tukey test was run on the data in R in order to do the comparison between the means of the values.

3. Discussion and Outcomes

3.1 Hydrolysis by Enzymes

About 11.93 percent of the peptide links were disrupted after four hours of hydrolysis by pepsin, and part of the proteins reached the aqueous phase.

Without enzyme hydrolysis, the amount of supernatant is much smaller than what is produced after that (Table 1). Thus, it may be concluded that hydrolysis led to the biotransformation of the substance. Combining acid and base throughout hydrolysis may enhance the final material amount. The yields of the centrifugation and pellet fractions showed no discernible variation concerning the drying method.

Table -1: the products of hydrolysis fractions (%)

Dealing	Section	Oven aeration at 71°C	Freeze-drying
Controller	Supernatant	-	5
	Pellet	-	20
Hydrolysis by Enzymes	Supernatant	27	25
	Pellet	11	14

3.2 Reconstitution of Proteins

Table 2 shows that after applying pepsin, around 76% of proteins are identified in the sample extract or supernatant, demonstrating their aqueous solubility during the enzymatic breakdown, while only 17% of proteins pass into this fraction without enzyme treatment. On the other hand, although 68% of the original proteins were recovered in the pellet before enzymatic hydrolysis, only 23 percent of the total was recovered in this way afterward. Peptidase, or pepsin, breaks down proteins and makes them more soluble by reducing their overall size.

Table -2: Hydrolysis of fish scraps for protein extraction (%)

Dealing	Section	Oven aeration at 71°C	Freeze-drying
Controller	Supernatant	-	17

	Pellet	-	68
Reconstitution of Proteins	Supernatant	78	76
	Pellet	24	23

3.3 Influence of drying method on constituents

- Humidity

What happens to the finished items' moisture levels depends on the drying technique used. The impact varied between samples. Freeze-drying the raw materials yields a greater moisture content, whereas supernatant and pellet freeze-drying yield lower moisture levels (Table 3). The condition of the material, whether crystalline or amorphous, is crucial to the success of the freeze-drying process. More than 21% of the previously frozen liquid is connected with the solid particles and must be removed by desorption in an amorphous structure [6], in the way of comparison to the solid ice, which is removed by vaporization during freeze-drying. It's possible that the diverse responses to freeze-drying might be attributed to the samples' varying degrees of uniformity.
There is little to no moisture present, which extends the product's life in all circumstances. Those results align with the 3.4-8.5% range found in powdered tuna co-products by Abbey et al. [12].

Table -3: Humidity content in g/100g of example

Experimental	Conditioned air at 70 degrees Celsius	simply freeze
Minerals in their raw form	$5\pm0,05^{a}$	$12\pm0,23^{b}$
Supernatant	$6\pm0,05^{a}$	$15\pm0,12^{b}$
Pellet	$775\pm0,12^{a}$	$17\pm0,03^{b}$

There are four observations included in the analysis. Hence the data is provided as a mean SD (n=4). Tukey's assessment for sub-sampling shows that means split by the identical letters on the same sheets really aren't substantially different from one another ($p>0.05$).

- Proteins

Table 4 shows that the trimmings have a protein composition that is comparable to that of tuna trimmings, as reported by Abbey et al.
The protein concentration is greater in the precipitate than in the original sample. After adding hydrochloric acid and potassium hydroxide for acid hydrolysis, there may have been a diluting impact. So, even if the protein level is high, the crude ash concentration rises.
The drying method had no effect on protein concentrations ($p>0.05$) (Table -4). Chen et al. [13] found that dry and freeze-drying egg white had identical results in terms of structure. Soy isolate is another example of a food whose protein content remains constant regardless of the drying method [14].

Table -4: Protein concentration expressed as a percentage of the sample's dry weight in grammes per hundred grammes

Experimental	Conditioned air at 70 degrees Celsius	Freeze-drying
Minerals in their raw form	$76\pm2,21^{a}$	$74\pm0,24^{a}$
Supernatant	$71\pm0,24^{a}$	$70\pm0,74^{a}$
Pellet	$48\pm0,03^{a}$	$45\pm0,71^{a}$

Results are shown as a mean standard deviation (n=3). Tukey's test for independent samples shows that means separated by the same letter on the same line are not actually that different from one another ($p>0.05$).

- Lipids

The drying process has a substantial bearing on cholesterol levels (p 0.05), according to statistical analysis (Table -5). Pellets and raw materials that have been freeze-dried have a higher concentration of lipids than pellets and raw materials that have been oven-dried. These discrepancies might be explained by the natural propensity of lipids to adhere to the surfaces found on the interior of containers. Kiln-drying zebrafish leads to lipids loss due to lipid evaporation, absorption of water, and high temps handling, as reported by Chukwu and Shaba [15]. (61-71 degrees Celsius for 24 hours).

Table -5: The number of lipids in the sample, expressed as grammes per one hundred grammes of dry weight

Experimental	Conditioned air at 70 degrees Celsius	Freeze-drying
Minerals in their raw form	$14\pm0,61^{a}$	$17\pm0,48^{b}$
Supernatant	$7\pm0,61^{a}$	$5\pm0,35^{b}$
Pellet	$22\pm1,32^{a}$	$23\pm0,62^{a}$

The data are shown as a standard deviation (n = 3). Tukey's test, assuming a 5% likelihood, reveals that means preceded by the identical symbol within the same table are insignificant (p>0.05).

- Ash

The ash level of the freeze-dried items was significantly greater than that of the broiler products (p 0.05). (Table -6). It's possible that leaching occurred when the substance was dried at 70 degrees Celsius.

Table -6: the amount of moisture in grammes per one hundred grammes of sample

Experimental	Conditioned air at 70 degrees Celsius	Freeze-drying
Minerals in their raw form	$11\pm0,12^{a}$	$12\pm0,29^{a}$
Supernatant	$25\pm0,02^{a}$	$16\pm0,45^{b}$
Pellet	$27\pm0,08^{a}$	$17\pm0,04^{b}$

The values are reported as the mean and standard deviation (n = 3). According to the results of the Tukey test, which assumes a probability of 5%, means that are accompanied by the identical letter within the same line really aren't statistically meaningful from one another (p>0.05).

3.4 The influence of the drying method on the operational qualities

In any event, the functional qualities of freeze-dried items, as opposed to those that are oven-dried, are significantly improved. The majority of responsibility for these functional characteristics lies with proteins. Because the drying techniques did not impact their contents in any way, the modification in their architecture may have occurred while the drying activities were being carried out, which may be responsible for their functional qualities. Proteins, for instance, get denaturated when subjected to temperatures too high [17].

- Capacity for the absorption of water

The soluble fraction does not possess any potential for the transpiration of water. Regarding pellets, the volume of freeze-dried samples is significantly larger than that of dried-in oven specimens (p 0.05). (Fig-1). The more extraordinary porous nature of the lyophilized sample might be responsible for the significant water absorption observed [16].

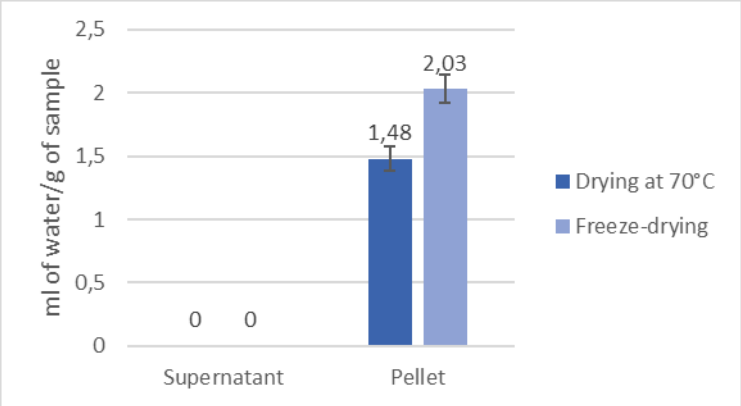

Fig -1: Using two different drying processes, the moisture capacity of the hydrolyzed portions

• Capacity for the soaking up of oil

Both the dissolved and insoluble parts have hydrocarbon properties. Surplus amounts tend to have the highest densities. Freeze-dried compounds may attain capabilities that are only slightly higher than those obtained with materials frozen at 70 degrees Celsius (Fig-2). Thermally white face fish hydrolysates [17], chicken skin gelatin [16], and garbanzo protein concentration [18] have been found to have greater capacities than preheat materials. It is speculated that the increased density of non-polar on the surface [17] and the more high porosity [16, 18] of thermal degradation materials are to blame for this phenomenon.

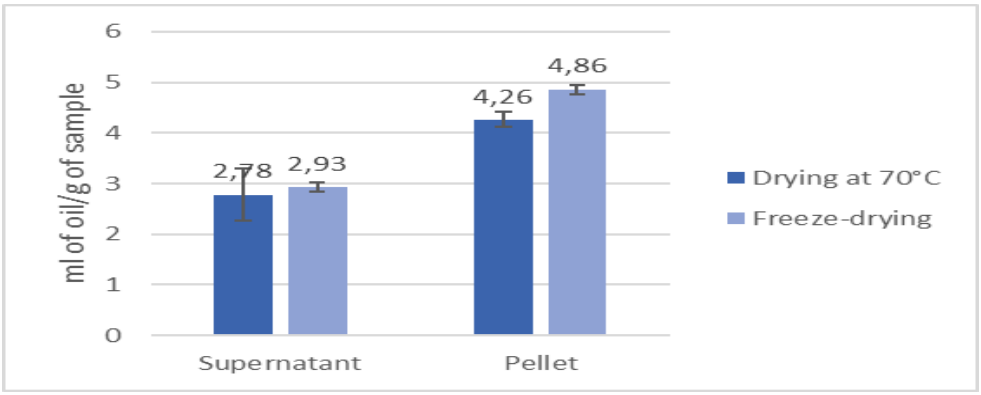

Fig -2: Capacity for oil absorption of degradation components utilizing the two different drying processes

- Capability to form emulsions

The filtrates, in contrast to the pellets' absorbency and water content activity, have much greater emulsifying capacities (Fig -3). Cooling, in comparison to drying at 70 degrees Celsius, is a more successful method for generating fractions that have emulsifying qualities. This is because freeze-drying uses lower temperatures.

According to Linarès et al. (2001) [19], emulsification ability did not change throughout the drying kinetics. Chen (2011), in comparison, reported results that were consistent with the present study. The variances may be traced to the fact that the structures of the precursor proteins are distinct from one

another. The emulsifying ability of proteins may be determined by analysing their water - insoluble characteristics, in addition to their charge [13].

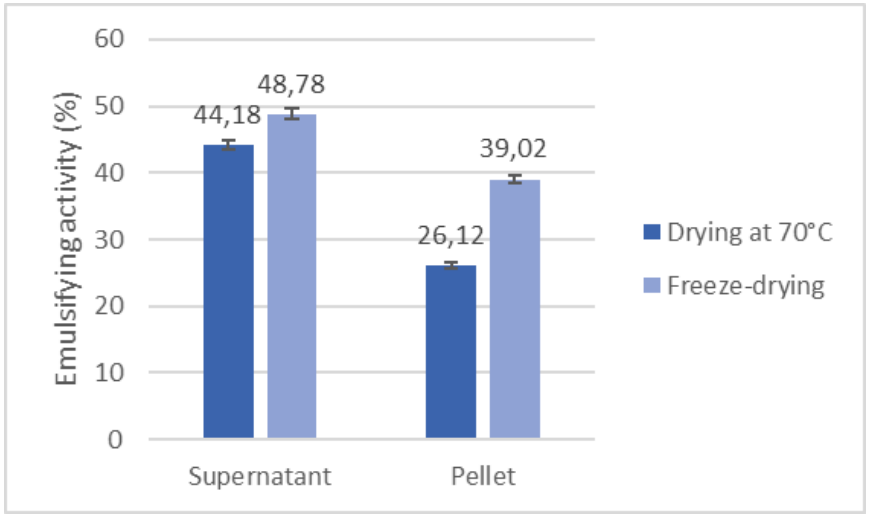

Fig -3: Comparing the emulsifying potential of hydrolysis separates using two different drying techniques

- The consistency of the emulsion

Even though soluble fractionals exhibit fascinating stability patterns, the insoluble fractions produce emulsions more resistant to instability (Fig-4). If the solubility that can be achieved with sodium caseinate is 80.90%, then it can be achieved with the trimmings protein hydrolysate at 81 to 87%. After that, the products might be used in the agricultural business as natural thickeners.

Drying at 70 degrees Celsius offers somewhat less stability than drying at minus 196 degrees Fahrenheit. Indeed, drying techniques may change the denaturation of proteins, as well as their hydrophobicity, anhydrides, and particle size [14], which can lead to variances in the characteristics.

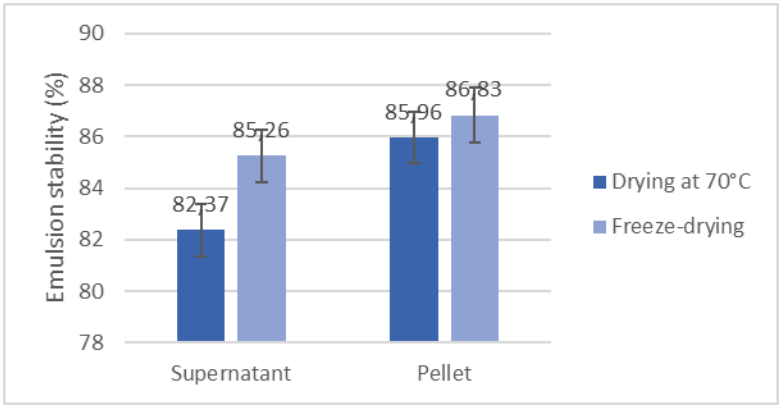

Fig -4: Using two different drying processes while maintaining the emulsifying stability of something like the hydrolysis components

4. CONCLUSIONS

Fish trimmings could have a high protein content. As expected, pepsin hydrolysis is very effective in emulsification these native molecules. Proteins preserved by drying at 70°C and by dehydrating both show fascinating functional features, although those preserved by freeze-drying have a slight edge. Dehydration at 70 degrees Celsius or freezing is possible for enzymes. Additional study of protein sequence and morphogenesis during evaporation may help corroborate these findings. More research into the most efficient use of this Method is required if oven drying is to become more economically viable. Whatever the case may be, using fish scraps as a raw material for commercial products is an intriguing and possibly productive way for the food industry to create new kinds of bioactive components.

5. ACKNOWLEDGEMENT

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