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UTILIZATION OF FISH BONES AS BIOCERAMICS INDUSTRY MATERIAL

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Abstrack
Tuna is a fishery product that has high economic value. In processing, many parts of Tuna have not been fully utilized. Tuna fish bones are mostly left alone even though they can be used as a bioceramic from the hydroxyapatite. The bioceramics of Tuna Fish Bone Hydroxyapatite can be utilized in the medical field and this certainly helps in utilizing fishery waste products.

Keywords: Tuna, Hydroxyapatite, Hydrothermal Synthesis

Introducing
Indonesia has abundant marine natural resources, one of which is Tuna. Tuna has high economic value, and is one of the largest foreign exchange earners after shrimp. However, the utilization is still limited to the meat, while for other parts it has not been fully utilized (Nurilmala, et al, 2006: 22) [5]. So it is necessary to use fishery waste as a form of concern for environmental preservation.

According to M. Nabil (2005), fish contains organic waste with the main component of bones. Fish bones account for 10% of the total body weight of fish, which is one of the fish processing wastes. [8] In the fisheries industry waste fish bones and scales can be reprocessed into fertilizer or even reprocessed to obtain a biomaterial called calcium hydroxyphosphate or hydroxyapatite (HAP) [13]. HAP (Ca10 (PO4) 6 (OH) 2) is derived from fish bone waste containing calcium, phosphorus and carbonate [10]. HAP is biocompatible, non-toxic and non-inflammatory [12].

Tuna Fish (*Thunnus* sp.)
Tuna is a large pelagic fish that can swim fast and sway very far [1], when it is caught mature enough the tuna will travel long distances and then return to its breeding area [19]. Classification of Tuna (Thunnus sp.) According to Myers, P., et al (2021), is as follows [6]:

Kingdom : Animalia
Phylum : Chordata
Class : Actinopterygii
Order : Perciformes
Family : Scombridae
Genus : Thunnus

Tuna fish has a standard length (PB) ranging from 56.0-103.8 cm, head length (PK) between 15.1-29.0 cm, length of the first dorsal fin (PD1) between 13.6-21.4 cm , second dorsal fin length (PD2) between 4.0-8.9 cm, pectoral length (PP) between 10.7-31.3 cm, height (TB) between 17.1-31.3 cm [4] . Tuna can be found at depths of 35-300 m with temperatures of 12o-17oC [3]. Tuna fish has a high nutritional content. This is influenced by species, species, age, season, metabolic rate, movement activity, season and level of gonad maturity [7].

Process

According to V.P Orlovskii (2002), making HAP can be done through two main methods, namely synthetically and from natural sources. HAP derived from natural sources has better metabolic activity, is cost-effective and reduces environmental problems [16]. In addition, synthetic HAPs are time consuming, complex, and expensive. According to Nayak (2010), over time, hydroxyapatite synthesis can be carried out by several methods such as the sol-gel approach technique, hydrothermal technique, biomimetic technique, deposition technique, electrodeposition technique and others. Hydrothermal synthesis is a popular technique because it can produce particles with good crystallinity and do not experience agglomeration, and produce uniform shapes and compositions (Suchanek and Richard, 2006: 184). Hydrothermal synthesis in the process utilizes single-phase reactions at high temperature (T> 25oC) and pressure (P> 100 kPa) [5].

The tools used in the extraction of hydroxyapatite from fish bones include digital balance (accuracy 0.001 g), oven (maximum temperature 210℃, room capacity 150 L, 220 V), hammer mill (Fritsch Pelverisette, 100 mm), sieves / filters (Retsch Sieve and Shaker AS 200 basic, 100 mm / 150 mm / 200 mm), furnace (Vulcan 3-130 and Nabertherm, temperature range 50-1,100℃, 220-240 V, 1,060 W). And the tools used for FTIR analysis are the Bruker Tensor 27 spectrophotometer (spectrum range 4,000-400 cm-1, with KBr standard beam splitter, interferometer: Rocksolid, detector: digitech detector system), X-ray Diff ractometer device SHIMADZU brand type XD-610 (Cu NF type X-ray tube, vertical type geniometer with a scanning radius of 185 mm and a scanning angle range of -6 ° ~ 163 ° (2θ), -180 ° ~ 180 ° (θ) [18].

The first step in the manufacture of hydroxyapatite is the preparation of tuna [9]. Preparation is done to remove the remaining meat that is still attached. Preparation begins with boiling 2 kg of fish bones. Boiling was carried out at a temperature of 80℃ for 30 minutes. After that, cleaning the meat that is still attached and washing it with water and finally washing it with distilled water. Then, soaking with acetone solution (ratio of fish bones to acetone is 1: 2) for 24 hours, to remove various other impurities. [18].

Then hydroxyapatite synthesis was carried out with sintering temperature variations of 400 ° C, 600 ° C, and 800 ° C for 6 hours (Venkatesan and Kim, 2010). The hydroxyapatite obtained was analyzed by several tests including: yield, proximate, whiteness and heavy metals (Hg, Pb, and Cd) and mineral analysis with AAS. Tuna fish bone nanohydroxyapatite is made by sizing (size reduction) hydroxyapatite from the results of the best sintering temperature treatment method, followed by Nanoblend Ball Mill for a certain time (modification Rajkumar et al., 2011). The resulting nanohydroxyapatite particles were measured using PSA, morphological analysis of crystallinity using XRD and functional group analysis using FTIR. [9].

With the flashlight temperature, the yield decreased. This can be expected to occur due to the loss of water content and organic matter contained in the powder [20]. In addition, the crystallinity will be higher as the temperature used in the sintering process increases. The following is a proximate table composition obtained from Fish Bone Flour:

Tabel.1 Proximate Composition of Tuna Fish Bone Flour [17]

Sample	Proximate (%)			
	Moisture	Ash	Protein	Fat
Bone powder	4.25±0.22[a]	72.02±0.37[b]	15.30±0.09[a]	1.53±0.05[a]
Milling	0.52±0.04[b]	98.43±0.42[a]	0.46±0.02[b]	0.39±0.02[b]
NaOH	0.37±0.04[b]	98.66±0.56[a]	0.39±0.02[b]	0.24±0.02[c]
HCl	0.33±0.05[b]	99.03±0.47[a]	0.19±0.01[c]	0.22±0.02[c]

Please note that there are chemicals used in the synthesis route, which are dangerous and corrosive such as phosphorus (P) which can cause damage to blood vessels when inhaled. For this reason, caution is needed in conducting research [2].

Utilization

Hydroxyapatite is a bioceramic whose composition and structure are almost the same as that of natural bone mineral. In medicine, the use of hydroxyapatite is used in the fields of orthopedics, neurosurgery and dentistry. In teeth, hydroxyapatite is used as a filler in holes or cavities [11]. 70% matched human osteoblast cells [15]. Indonesia, as a country with the highest number of fracture sufferers in Asia, is certainly greatly helped by the use of hydroxyapatite, because it is possible to be used as a remineralization and repair material for hard tissue because it is composed of calcium and phosphate which are similar to bone constituents [6]. However, the use of hydroxyapatite as a bone implant is very vulnerable, because it is easy to brittle [14].

Conclution

The bioceramics of Tuna Fish Bone Hydroxyapatite can be utilized in the medical field and this certainly helps in utilizing fishery waste products.

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