__Review Article__

Utilization of fish bone waste for food

ABSTRACT

This article study aims to explain the use of fishbone waste in its processed form on the daily food product, to analyze to an extent it's strength and potential in Indonesia and identify its usage. The method used in this study is a qualitative descriptive method using secondary data sources. This research is done by reviewing and analyzing various literature data correlated to fish bone usage. From the associated data, it's discovered that fish bone mainly used as a calcium source in wich has different value depending on the sources. The utillization of fish bone as food ingredients is mainly used as a substitute or an additive used for product improvements and still being developed to this day.

Keyword: Fish bone waste; calcium; food; human consumption.

1. INTRODUCTION

Based on the Central Bureau of Statistics; in 2018 in West Java alone the production of tilapia was 242,325 tons and catfish as much as 21,149 tons while in 2019 the production of tilapia was 294,089 tons and catfish was 22,425 tons [1]. Aquaculture production for the second quarter of 2020 was 7.7 million tons or (83.24.8%) of the target set for 2021 production of 9.2 million tons [2]. The fish processing industry is one of the biggest contributors to fish bone waste. The wealth of marine fish productivity owned by Indonesia in 2006 was 2,752,838 tons, with the largest marine fish production coming from tuna fish around 31.2%, skipjack 26.9%, mackerel 17.2%, and tuna 14.1%., and other types of fish 10.7%. The average per year for fish productivity in Indonesia has increased by 5.5% for tuna species [3].

Fish bones are one of the residual forms produced from the fishery product processing industry which has the highest calcium content in the fish body. From the aspect of food and nutritional needs, fish bones are very rich in calcium that humans need because the main elements of fish bones are calcium, phosphorus, and carbonate [4]. Therefore, the involvement or participation of the fisheries waste processing industry is needed to utilize fish bone residues directly in every process carried out to achieve development efforts through the utilization of fish bone residues that can be utilized into various food products. If fish bone waste is not utilized, then the loss is as much as the potential benefits and economic value that can be obtained if we utilize the fish bone waste. Therefore, the involvement or participation of the fisheries waste processing industry is needed to utilize fish bone residues directly in every process carried out to achieve development efforts through the utilization of fish bone residues that can be utilized into various food products. If fish bone waste is not utilized, then the loss is as much as the potential benefits and economic value that can be obtained if we utilize the fish bone waste. Fishery waste is waste obtained from fishery processing which can cause environmental pollution. Pollution cannot be avoided if waste disposal is carried out without prior waste treatment or waste utilization [5].

According to [6], hockey fish bones (*Johnius belangerii*) contain about 30.54% (wk) organic matter consisting of 28.04% protein, 1.94% lipid and 0.56% carbohydrate, while the inorganic mineral material is around 69, 46% (bk) mainly consists of 59.69% calcium (Ca) and 35.81% phosphorus (P). Utilization of fish bones as a source of dietary calcium is one of the efforts in order to meet the needs of food calcium while increasing the economic value of the fish bone waste. Fish bone waste has the potential to be used as a source of calcium in the human body and used in the processing of food products that are easily accepted by the community [7]. Humans have different needs for calcium at each age. The calcium requirement for children aged 1-6 years is around 500 mg/day, while children aged 7-9 years is 600 mg/day. Calcium needs of people aged 19 to over 65 are higher than the calcium needs of children, which is 800 mg/day. Adolescents aged 10-18 years need calcium the most among other groups, which is 1000 mg/day [8]. In order to avoid osteoporosis, calcium needs must be fulfilled from a young age, so an innovation is needed to increase the calcium content in a diversified diet, and which can reduce pollution from fishery waste [9]. The purpose of this article is to provide an overview of the potential of fish bone waste for the development of products for human consumption.

2. FISHERIES WASTE AND FISH BONE

2.1 Fisheries Waste Condition

Processing activities of fishery products generate by-products in the form of waste. Waste is processed residue or waste generated from a production process both from industry and from a domestic (household) which has no economic value [10]. Fish waste is waste obtained from fishery processing which can cause environmental pollution. Pollution cannot be avoided if waste disposal is carried out without prior waste treatment or waste utilization [5]. Almost 3⁄4 of the total weight of fish is waste [2]. Fish waste consists of bones, skin, fins, heads, scales, and offal. Thus, fish waste is one of the biggest problems in the fish processing industry. According to [11], fish waste can pollute the environment both on land and in waters, even though fish waste still contains quite a high protein.

Waste is the result of activities that cannot be used anymore, while the by-products can still be used further. Waste utilization innovation will play a role in the economy if it is supported by accommodative institutions. Processed by-products from fishery products are quite diverse, but in general they can be divided into by-products in liquid form and by-products in solid form [12]. Fishery waste contains nutrients that are no different from the main ingredients and its use has also been widely studied, including being studied as a medium for the growth of microorganisms.

In the market, fish waste is simply thrown away so that it becomes a gathering place for microbes and causes bad or foul odors. To cope with fishery waste, efforts are made to utilize the waste to make it more useful and not cause environmental pollution [10]. One alternative to the utilization of fishery waste is to process it into a product that has a selling value.

2.2 Fisheries Waste Opportunity

General fisheries and aquaculture production (except for algae) has substantially improved inside the beyond seven decades going from 19 million tonnes (live weight equal) in 1950 to an all-time document of approximately 179 million tonnes in 2018, with an annual growth rate of 3.3 percent. production then declined marginally in 2019 (a fall of one percentage as compared with 2018), before increasing by using a trifling 0.2 percent to attain 178 million tonnes in 2020 [13]. total global fish production in 2020 become 177.8 million tonnes (MT) (marine capture fisheries: 78.8 MT + freshwater capture fisheries: 11.5 MT + aquaculture: 87. five MT). Out of which 157.4 MT turned into directly consumed by using humans.

quantity of production misplaced to spoilage or thrown away after touchdown and prior to consumption was 42.5 MT (27 % of all landings).

Table 1. World Fisheries and Aquaculture Production and Utilization

	2018	2019	2020
	Million tonnes (live weight equivalent)		
Production Capture:			
Inland	12.0	12.1	11.5
Marine	84.5	80.1	78.8
Total *Capture*	**96.5**	**92.2**	**90.3**
Aquaculture:			
Inland	51.6	53.3	54.4
Marine	30.9	31.9	33.1
Total *Aquaculture*	**82.5**	**85.2**	**87.5**
Total world fisheries and aquaculture	**178.9**	**177.4**	**177.8**
Utilization			
Human consumption	156.8	158.1	157.4

Source: [14]

Meanwhile, based on Ministry of Marine Affairs and Fisheries in Indonesia, the fish consumption in 34 provinces of Indonesia in 2019 reached 55.95 kg/capita/year.

Based on the Central Bureau of Statistics; in 2018 in West Java alone the production of tilapia was 242,325 tons and catfish as much as 21,149 tons while in 2019 the production of tilapia was 294,089 tons and catfish was 22,425 tons [1]. Aquaculture production for the second quarter of 2020 was 7.7 million tons or (83.24.8%) of the target set for 2021 production of 9.2 million tons [2]. Knowing this, it can be concluded that fishery production will continue to increase which will also increase the production of fishbone fish waste. This makes the utilization of fish bone waste one of the prospects that can be easily done if we know what its uses are in everyday life.

The fish processing industry is one of the biggest contributors to fish bone waste. The wealth of marine fish productivity owned by Indonesia in 2006 was 2,752,838 tons, with the largest marine fish production coming from tuna fish around 31.2%, skipjack 26.9%, mackerel 17.2%, and tuna 14.1%., and other types of fish 10.7%. The average per year for fish productivity in Indonesia has increased by 5.5% for tuna species [3]. In addition, the tuna fishery is also one of the most important fisheries in the world, including Indonesia. Indonesia is also a country with the highest tuna potential in the world with a record of total tuna production at 613,575 tons per year with a sales value of Rp. 6.3 trillion per year. As much as 70% of Indonesian tuna production is exported to Thailand, China, Japan, the United States and the European Union [15]. The majority of Indonesian people consume tuna that is already in the form of fillet (boneless), so that tuna fish waste, such as heads, bones, scales, and abundant skin, is simply wasted [16]. One of the largest wastes that can pollute the environment is fish bone waste with an amount of about 20% of the total body weight of fish. Therefore, Indonesia has a high potential for the utilization of fish bone waste.

There are several types of fishery industry waste disposal such as bones, heads, scales, tails, offal, and fish skin. The fishery waste discussed this time is in the form of fish bone waste that can still be consumed by humans. Utilization of fish bones as a source of dietary calcium is one of the efforts to meet the needs of food calcium while increasing the economic value of the fish bone waste. Fish bone waste has the potential to be used as a source of calcium in the human body and used in the processing of food products that are easily accepted by the community [7].

2.3 Fish Bone

Fish bones are one of the residual forms produced from the fishery product processing industry, which has the highest calcium content in the fish body. From the aspect of food and nutritional needs, fish bones are very rich in calcium that humans need because the main elements of fish bones are calcium, phosphorus, and carbonate [4].

Currently, the utilization of fish bone waste is not optimal, even though the waste can be used and reprocessed into various processed products that are rich in calcium. The fishing industry, most of its waste, is simply thrown away without any further handling process. With this, there is a need for innovation to process waste more optimally into useful ones without polluting or polluting the surrounding environment [3]. To overcome this, there are several innovations such as fishery industry waste being an additional ingredient in the food production process. The innovation is by utilizing fish bone waste. Fish bone waste is always a lot and wasted in vain without being treated properly [17].

Therefore, the involvement or participation of the fisheries waste processing industry is needed to utilize fish bone residues directly in every process carried out to achieve development efforts through the utilization of fish bone residues that can be utilized into various food products. If fish bone waste is not utilized, then the loss is as much as the potential benefits and economic value that can be obtained if we utilize the fish bone waste.

3. FISHBONE NUTRIENT

The World Health Organization recommends the recommended daily intake of calcium for adults is around 400-500 mg, but if protein consumption is high, it is recommended to consume 700-800 mg. For children, intake is higher and for pregnant/breastfeeding women it is recommended to consume 1200 mg [18]. There is recommended as the best source of calcium milk, but the price of milk for some people is still relatively expensive; it is necessary to find an alternative source of calcium that is cheaper, easy to obtain and of course easy to absorb.

Fish bones are a form of waste that has the highest calcium content among fish body parts. Fish bones that are made into flour have a high mineral content, especially calcium, so they can be applied to a form of food product that is acceptable to consumers. From the point of view of food and nutrition, fish bones are very rich in calcium that humans need, because the main elements of fish bones are calcium, phosphorus, and carbonate [19].

Table 2. Nutrients in fish bone

Nutrients	Amount of Nutrients in Fish Meal (%)
Water Content	3.12
Protein	28.04
Fat	1.94
Calcium	59.69
Phosphor	35.81

Source: [5]

Calcium deficiency in the adult group can cause osteoporosis, which is characterized by loss of bone density so that bones become brittle and prone to fractures if the patient falls [20]. The prevalence of osteoporosis in Indonesia is quite high, reaching 53.6% in women and 38% in men over 70 years, and 18-36% in women and 20-27% in men under 70 years.

4. FISHBONE AS A PRODUCT

4.1 Fish Bone Powder

Fish Bone powder is a byproduct obtained through waste processing of fish bone, in wich is approximately 10-15% of the whole body weight of the fish [21]. The major component in the bone powder was ash content which, in several species could be up to 40% [22]. Back in 2006, [1] pronounce a positive effect on growth and feed efficiency on dried fish bone usage as feed ingredient in diets for fish and other animals compared to their traditional diets counterparts. Fish meal obtained from whole fish or fish by products contains approximately 10% minerals, particularly high calcium content and phosphorus, and represent as a significant source of minerals once included in feed [22].

In 2012, there was a research about the effect of food powder on human food and reported that the coarse particle of fish bone has a negative effect on food sensory quality, especialy the grittiness. This feature can be minimized by decreasing the particle size of the fish bone powder to a minimum of 100µm. Futhermore, the functionalities of the fish bone powder done this way also improved as it has been found that the smaller the particle size of the fis bone powder, there is an increase in the fluidity, solubility, electric conductivity, water holding capacity, and calcium bioavaibility [18]. Fish bone has been reported to be utilized as edible powder for food ingredient and calcium supplementary by some of modern products [23] [10].

The process to preparing fish bone powder according to [24] generally comprising at least 4 steps: Pre-Heating, Removing the impurity, Drying, and Milling to derive a 18-22g / 100 g calcium rich powder with substantial levels of protein, fat, and essential minerals such as sodium and phosporus. Each references had their own methods depending on the end products.

The first step is usually removing the impurities by separating the bones from any remaining flesh and blood, followed by boiling process. [9] state that fish bone is boiled at 80°C water for 30 minutes then sterilized by autoclave machine (121°C, 1 atm) then the bones were cutted and boiled again for 30 minutes at 100°C. Then extract the bones with 1,5 M NaOH for 2 hours at 60°C before the bones cleaned , dryed, and milled to a powder. [19] reveal this methods was called alkaline treatment method and used to remove the protein and fat content of the bone while focusing primarily on the ash content. Nemati was using modified alkaline treatment method by [24] and [25]. In her study, initially, 500 g of Tuna bone frame were boiled in 2% sodium hydroxide solution (NaOH) for 30 minutes at a ratio of 1 part tuna frame to 3 parts NaOH solution (w/v). The soaked bones were filtered with a filter cloth and then, the filtered bones were washed with 1% hydrogen chloride (HCl) and deionized water to neutralize completely. The washed bones were then dried in a hot air oven for 2h at 100°C and were ground into the fine powder until passing a sieve of 100 mesh size [19].

The usage of fish bone powder as calcium source can be seen on the development of calcium health supplement from yellowfin tuna (*Thunnus albacares*) by [19] with the product goal of calcium pill to reduce the victims of osteoporosis. On the table below, we can see that fish bone powder has a great amount of calcium per 100 grams.

Table 3. Amount of ash and calcium in fish frame and bone powder (g/100g) [19].

Fish frame	Fish bone powder	Ash	Calcium
Tuna [19]		55,43	24,56
Cod [22]		57,70	19,0
Saithe [22]		57,60	19,9
Blue whiting [22]		50,30	17,0
Salmon [22]		42,40	13,5
Trout [22]		44,10	14,7
Herring [22]		47,50	16,1
Mackerel [22]		43,80	14,3
Tilapia [26]		21,33	
Tilapia [27]		20,62	
Hoki [28]		69,50	

Fish frame	Fish bone powder	Ash	Calcium
Hoki [25]		39,78	
	Tuna [19]	77,97	38,16
	Tilapia [29]	75,83	
	Oilsardinev [30]	91	32,73
	Ribbon fish [30]	95	27,81
	Catfish [31]	61,8	21,00
	Snapper [31]	71,2	24,40
	Salmon [31]	65,8	22,30
	Hoki [25]	77,03	

Even though fish bone powder was mainly used as a calcium source, it is revealed that it's usage is quite few for a main supplement and more of a substitute with a small nutrient boost. Fish bone powder as a main ingredients generally used as a substitute for another flour that used for hardening the product such as *kerupuk* (fish crackers), and sausages.

Crackers are a type of snack that undergoes volume expansion to form a porous and low density product during the frying process. Crackers are generally made from tapioca flour as a source of starch with the addition of spices and water to form a dough [32]. Fish bone usage on fish crackers were done by [33] which resulted in higher calcium, phosphor, ash, and whiteness [33].

Another usage of fish bone powder can be seen in the manufacturing of fish sausages. Fish sausages is nutririous, wholesome, palatable, and relatively low-priced product made from grinded fish meat, fat, seasoning, and cereal filler. Fish sausage is a processed fishery products with raw materials of crushed fish meat or surimi, at a minimum 50%, mixed with flour and other ingredients, filling into sausage casings and experiencing boiling or steaming. [34] state that the usage of fish none powder resulted in a decrease of moisture content while slightly increased the fat and protein while calcium content increased 15-fold resulted in an improved hardened gummy-like sausages [34]. In his previous research, he also reveal that the sensory evaluation indicate the calcium extract exhibited higher overall acceptance than the control [35].

4.2 Fish Bone Flour

Fish bones waste is produced as a dry preservation that is processed into flour to create fishbone flour [36]. Fishbone flour is the utilization of fish bone waste from the processing industry and has the highest calcium content among fish bodies, this is because the main elements of fish bones are calcium, phosphorus and carbonate [37]. Up to 14% of the total bone structure in fish bones is calcium in the form of calcium phosphate [1]. Calcium and phosphorus combine to generate calcium phosphate in an alkaline condition [32]. Calcium levels in various fish bone flour are presented in Table 4.

Table 4. Comparison of calcium content in various fishbone flour

Type of Fish	Bone Flour Calcium Level (%)
Chilata sp.[38]	29.68
Abalistes stellaris [39]	35.75
Paraplotosus sp.[40]	38.40
Thunnus sp.[41]	41.61
Pangasius sp.[40]	51.30
Clarias sp.[40]	65.90

The qualities and characteristics of the finished fishbone meal will vary depending on the fishbone used and the procedure used to make it. The methods and raw materials used to make different types of fishbone flour affect the variation in calcium content [37]. Fish bones can be extracted into flour by a straightforward process that involves boiling the bones in water, treating them with a base, treating them with acid, or combining these treatments [42]. The ash content, water absorption, and whiteness of fishbone flour improved when the solvents NaOH (Sodium hydroxide) and HCl (Hydrochloric acid) were used during the extraction process, however the protein content was not significantly different. While the boiling process of making fishbone flour will result in less stable physical qualities and make the bone flour easier to separate [43]. Calcium levels in fishbone flour can be affected by the boiling method used [38].

Water, ash, protein, and fat content are among the chemical components of fish flour. One of the crucial factors is water content because it has an impact on the food's quality [44]. The amount of water in food determines its acceptability, freshness, look, and flavor as well as its durability [45]. Products with low water content last longer because they don't contain as much water, which makes it difficult for bacteria that cause spoiling to grow on the product [39].

There are several different ways to make fish flour. Depending on the extraction method, bone flour production is classified. Based on the solution used in the immersion procedure with water, acid, and alkaline solutions, the extraction process varies [37]. According to [5], the process of making bone flour involves washing the fish bones and placing them in an aluminum pan with water that has a temperature of up to 80°C. Then, fishbones are cooked for 30 minutes, cleaned as thoroughly as possible with clean water, and drained. Additionally, the presto process took three hours, and the boiling process took place twice for 30 minutes. Two liters of water are brought to a boil at 100°C in an aluminum kettle to cook the bones. The fundamental method for extracting NaOH involves soaking the bones in NaOH solution for two hours at a temperature of 60 °C. After being laid out on a filter cloth, the bones are rinsed under running water. Following that, the fish bones are put on a tray that has been lined with aluminum foil. A drying oven was used to dry the bones for 48 hours at a temperature of 65°C. The flour is then blended, and after that it is sieved using a flour sieve.
In the context of utilizing fishbone flour, there are several products that use fishbone flour as a raw material or additional material. some products made from fishbone meal that have been made such as biscuits, cookies, and noodles. These products have been made through trial and research. Basically, this product aims to utilize fish bone waste and increase the nutritional and calcium levels in the product.

Biscuits are a kind of cake made from hard dough through a fermentation process or ripening, are flat and tend to have a salty taste and are relatively crunchy, and when broken, the cross section is layered [46]. Biscuits are popular snacks that are often found in the market, at least it's proven through its availability in almost all shops that sell snacks in urban areas to stalls in remote villages. This indicates that almost all layers of society are used to enjoying biscuits. Biscuits are favored because of their texture crispy and multi-layered and has a savory taste [46]. An example of this product is a biscuit made from skipjack tuna fishbone flour. Based on [46] research, skipjack bone flour here serves as an additional fortification of nutrients in biscuit food products. Of course, this additional nutrient is useful to increase the benefits of a product especially in this biscuit.

The next product is cookies, based on research by [47] and [48], fish bone waste can be utilized and processed into a product in the form of fish bone flour, and then processed into a derivative products in the form of cookies, fish bone meal are used as an additional materials in cookies with high calcium levels. Cookies are a food that can be enjoyed by all ages ranging from children, to adults, and the elderly [47]. Cookies is a processed product that has a high economic value and is one of the types of snacks made from wheat flour as the main raw material [7]. The main reason for choosing the product cookies (cookies) because it has a fairly high market share. Cookies consumers include all ages so that the presentation of products in the form of cookies can make it easier for people to accept this product as an alternative food's rich in calcium [48]. The formulation for making fish bone cookies is made by adding wheat flour as the material with the highest amount and some additional ingredients for making cookies. The addition of fish bone flour into the dough aims to substitute the amount of wheat flour [47].

The other product is noodles, noodles are a very popular food product and are consumed by many people. Generally the nutritional content of noodle products and their processed products is still limited, especially its protein and mineral content. In terms of nutritional value, noodles are full of carbohydrates and calories with relatively low protein contents. The nutritional content of noodles varies greatly, depending on the type, amount and the quality of the materials, as well as the method of manufacture and storage [49]. One of the ingredients that can increase the nutritional value of noodles is mackerel fishbone flour. The main elements of mackerel fish bones consist of calcium, phosphorus, and carbonate while those contained in small amounts are magnesium, sodium, phytate, chloride, sulfate, strontium. So that fish bone flour can be the main ingredient or an additional ingredient in making noodles.

4.3 Gelatin Extract from Fish Bones

Gelatin is a heterogeneous mixture of polypeptides obtained by hydrolysis of collagen from skin, bone, and animal connective tissue [50]. Gelatin has distinctive properties, namely it expands in cold air, can change reversibly from a colloidal form to a gel, can affect the viscosity and melting point of a material, can protect colloidal systems [16]. Because of the unique properties of gelatin, gelatin has many functions, emulsifier, thickening agent, stabilizer, matrix material for implants, alternative plastic (edible film), and binder.

Generally, the main raw material source of gelatin extraction comes from the skin and bones of cows or pigs. The use of these sources of materials will cause several problems, especially in countries with a majority Muslim population. This is because pigs are animals that are forbidden to be consumed and there are concerns about congenital diseases by livestock, such as anthrax and mad cow disease. In overcoming doubts about these problems, it is necessary to use alternative raw materials that are abundant, cheap, and halal, namely gelatin from fish [51]. Gelatin with raw material sources from fish and mammals has several differences, namely differences in gel strength and melting point. Fish gelatin has a lower gel strength and melting point than mammalian gelatin. However, the viscosity of fish gelatin is higher than that of mammalian gelatin [34].

The conversion of collagen to gelatin can be carried out through acid or alkaline extraction treatment. In the acid extraction process, type A gelatin will be produced with an isoelectric point of pH of 7-9, while the alkaline extraction process will produce type B gelatin with an isoelectric point of pH of 4.7-5.2 [52]. The process of extracting gelatin from the bones of white snapper (Lates calcarifer) is divided into several stages, namely degreasing, demineralization, extraction, and drying [53]. The degreasing process was carried out by soaking the fish bones in boiling water ± 70°C for ± 30 minutes. After that, the remaining meat and fat that are still attached are cleaned from the fish bones. Then the fish bones that have been cleaned of meat and fat are dried in the sun to dry and cut to a size of ± 1 cm. Then the demineralization process is carried out by soaking the cut bone in a solution of hydrochloric acid (HCL) for 48 hours until it becomes soft bone (ossein) and filtered. After that, the ossein was washed with distilled water to a neutral pH (6-7) and filtered. Then proceed with the extraction stage, demineralized ossein (soft bone) was extracted using a water bath at 70°C for ± 3 hours and the filtrate was filtered. After that, the drying stage was carried out by drying the extracted filtrate in an oven at a temperature of 50-60°C for 24 hours to become gelatin.

At this time, gelatin extraction has been carried out from various types of fish, including *Lates calcarifer, Clarias batrachus, Thunnus albacares, Katsuwonus pelamis, and Pangasius sutchi* [54]. Fish gelatin has also been widely applied in the food industry. For example, in food products such as ice cream, gelatin acts as a whipping agent [55]. In addition, gelatin can also be applied to food products such as jelly candy [56]. Gelatin gives unique characteristics to jelly candy, namely melt in mouth and affects the strength of the gel formed in jelly candy.

5. CONCLUSION

The use of fish bones as food is not a new thing and is a new concept used in the food industry. Fish bones are easy to find, have no innate value, take up quite a lot of space, and are generally not pleasant to maintain, so processing them will certainly have a positive impact, especially if they become objects of high use value. It is very rich in calcium which can take up 38.16 g / 100 g ash content and can easily be processed into basic powder, finely ground flour, or gelatin powder, which can be used for the manufacture of various food products consumed on a daily basis. The main selling point of using processed fish bones is its simplicity and its existence as a valid substitute that can be used as a main ingredient or additive, either as an ingredient or a substitute. With the variety of sources and qualifications, the prospect of its utilization is quite promising in the era of industrialization. With these facts, it is very possible for many further studies on the utilization of fish bone waste into a food product. with high prospects, is considered to be able to produce high economic value in the future

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