Hanjeli utilization as a functional food to support food sovereignty

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Abstract. The agricultural sector is currently still become the prime mainstay in national development. It is closely related to manifest and maintain the food sovereignty, provide employment, supporting community welfare, and become the source of various industrial raw material. One of the potentially developed agricultural product is ‘indeterminate’ cereals, named Hanjeli (Coix lacrimo-jobi L.). The plant has some advantages such as tolerance to drought and marginal soil conditions. The grains containing calcium, carbohydrates, fats, high protein, fiber, calcium minerals, phosphorus, iron, thiamine, riboflavin and niacin. Amino acids contained in hanjeli grains consist of amino acids tyrosine, arginine, histidine, glutamate acid, lysine and leucine. Hanjeli has a good prospect to be developed as a substitute for rice and to be processed into prestigious food (functional food). The increasing role of non-rice local food is able to substitute or complement rice or wheat through the development of processing technology for non-rice local food products, both in terms of product diversity and taste, packaging, size, etc. In addition of being consumed by the farmers themselves, hanjeli rice and hanjeli flour can be marketed as functional food products. The availability of superior and local varieties, processing technology, and knowledge about the benefits of functional food play an important role in the development of hanjeli as a future healthy food.

Keywords: hanjeli (coix lacrimo-jobi L), food, functional food

1. Introduction
Domestical food problems cannot be separated from the problem of rice and flour. The increasing of population and community dependence on imported carbohydrates products, especially flour, are important things that must be considered to manifest and maintain food sovereignty. In addition, during the year 2008 flour prices will likely continue to rise, due to the trend of conversion of wheat into biofuels and the increase of global food demands. According to Sadjad (2000) cite in Widowati (2003) [1], flour is more likely to be adapted and adopted in Indonesia rather than other alternative food, although the most people in Indonesia still consume cassava, corn, rice, sago or sweet potato. This trend is not only occur in upper middle class, but also in lower classes. Flour base food such as noodles, snack, bread, and cookies are become favourite food among them. Therefore, diversifying food consumption based on local commodities is one of the efforts to reduce the dependence on imported products and provide sufficient quantities of food at affordable prices.

Local food has a strategical position as a staple food substitute for rice. One of the cereals that has a good prospect to be developed in the community, is an indeterminate plants, called Hanjeli (Coix
The plant is tolerant to drought and marginal soil conditions and the grains containing calcium, carbohydrates, fats, and high protein. In Indonesia, Hanjeli is still a minor cereal that has not been widely used in Indonesia [2], although the grains are commonly used as a healthy soup enhancer for people in Japan and Thailand [3].

This plant grows and cultivated in southern and eastern Asia, can adapt to arid tropics, cold temperatures, and acidic or alkaline soil. It has a thin skin, so it's easy to separate the skin from the contents. In addition, it has a narrow variety, which only consists of hanjeli and sticky hanjeli. Nurmala and Irwan (2017) [4] said that Hanjeli grains can be used as source of food both for human and animals, pharmacy purpose and handicraft. The fat content of Hanjeli (7.9%) is the highest among other cereal such as rice, corn, millet, barley and sorghum. Even so, until now hanjeli utilization in the community is only as a raw material for hanjeli pulp.

According to Tensiska et al (2018) [3], the main content of Hanjeli grains is carbohydrate, followed by protein and fat, which are significantly higher than rice and corn. The results of the Qosim and Nurhala (2011) [5] study on exploration, identification and diversity characteristics of the hanjeli germplasm in West Java, showed that one of the Hanjeli accessions, Acc 28, contain of 71.81% carbohydrates, 10.89% protein, 1.38% ash and 5.18% fat. This high value of carbohydrate content indicates that Hanjeli can also be used as a substitute to rice, corn, barley, millet and sorghum although its carbohydrate proportion is lower than those other cereals. However, the protein content of hanjeli is higher than that of rice protein which is 8.8%, corn 10.5% and sorghum 11.4%. Furthermore, according to the other study, conducted in a more specific area of West Java, Bandung, fat content of Hanjeli is higher than rice, corn, and sorghum, which are respectively, 7.9%, 2.1%, 4.9% and 4.2% (Grubbendan Patohardjono, 1996 cite in Tensiska et al 2018) [3]. Hanjeli grains are more than just carbohydrate sources, they also could be used as medicines, especially Chinese medicines. Hanjeli contains bioactive components which have antioxidant, anticancer, hypolipidemic and anti-inflammatory activities (Hao and Yu, 2012 cite in Setiasih et al 2017) [6]. Other source said that Hanjeli has been widely used in traditional Chinese medicine because of its contains anodine, anti-inflammatory, antipyretic, antiseptic, antispasmodic, hypoglycemic, hypotensive, sedative, and vermifuge. These differences in chemical compositions and characteristics are strongly influenced by the post-harvest handling and the food processing (Chaisirichharoenkul et al 2011 cite inYuwono, 2015) [7]. Functional food is useful for preventing diseases associated with the immune, endocrine, nerve, circulatory systems etc., [8]. Based on these facts, like other plants that have high carbohydrate and proteins content, Hanjeli has an equal potential to be used as a substitute for rice and can also be used as a functional food. The use of hanjeli as a non-rice food source is expected to be help on the realization of food sovereignty and could support to achieve of food security.

2. Food sovereignty
The concept of food sovereignty has officially become a goal and also an approach in national food development, as stated in UU No. 18 of 2012 concerning Food, food independence and food security [9]. Food Sovereignty is the concept of fulfilling food through local production. It is a concept of fulfilling the right of good quality and culturally appropriate food, produced with a sustainable and environmentally friendly agricultural system. Based on UU 41 of 2009, Food Sovereignty is the right of the state and nation that can independently determine its food policy, which guarantees the right of food for its people, and gives the community the right to determine a food system that is in accordance with the potential of local resources. Food sovereignty could become the main strategy to achieve national food development goals, which is food security. Food sovereignty does not replace it, but being a complement or supporter, it is even become the basis for achieving true food security. By implementing the spirit of food sovereignty, food security in Indonesia will be better and achieved in a solid and equitable manner [9].
3. Functional food

Functional foods are distinguished as foods that not only contain nutrients, but also active components to provide health benefits. Therefore, functional food must meet sensory, nutritional and physiological requirements [10]. According to the American Dietetic Association (ADA), this definition of functional food includes not only natural food but also fortified or enriched food that consumed as part of a food menu that varies in doses. With these definition, Some of Indonesian agricultural product are potentially to be developed into functional food. For example, corn (*Zea mays*), sweet potatoes (*Ipomoea batatas*), starfruit, carrots, and even marine products such as microalgae.

The functional properties of functional food are determined by the bioactive components in it. These bioactive components are spread in many Indonesian food. Therefore, Indonesia is in rich with potential functional food. Meanwhile, food technology and research related to functional food has also started to be developed. This all becomes the basic capital for developing functional food. Functional food that will develop rapidly in the future is closely related to food that can inhibit the aging process, increase body immunity, and improve fitness [11].

3.1. Functional food requirements

There are some requirements for a food to become a functional food. These three things below are the at least be fulfilled:

1. It must be food products, not capsules, tablets or powders and come from naturally occurring ingredients.
2. Can be consumed as part of a diet or daily menu, and
3. Functional food must have a certain function at the time of digestion, give a role in certain body processes, such as strengthening the body's defense mechanisms, preventing certain diseases, helping to restore body condition after certain diseases, maintaining physical and mental conditions, or slowing the aging process.

Materials or ingredients that increase health status are classified as follows: dietary fiber; oligosaccharides; sugar alcohol; amino acids, peptides and proteins; glycosides; alcohol; isoprenoid and vitamins; choline; mineral; lactic acid bacteria; unsaturated fatty acids; phytochemicals and antioxidants [12].

4. Hanjeli and its nutritional composition

Hanjeli is a type of tropical plant from the grain group. Some of its varieties have edible grains and are used as carbohydrate sources. Hanjeli is a local name that popular in West Java (Sunda), name Jali is more common for other Indonesian people [13]. Hanjeli has a good nutritional value, easy to be cultivated, less pests and diseases, tolerant to drought, flood and marginal soil conditions, and responsive to fertilization. This plant spreads in various agricultural land ecosystems which are diverse from dry, wet, dryland and wetland climates in Sumatra, Sulawesi, Kalimantan and Java.

There are two popular varieties of Hanjeli, first is lacryma-jobi which has a white hard shell, oval shape and is used for beads. Second is Mayue which is consumed by human and is used as Chinese medicine. Hanjeli is an annual plant with plenty clumps, the stems are upright and large, 1–3 m in high, and the roots are rough and strong. The location of the leaves intersperses, the leaves are ribbon-shaped with 8–100 × 1 5 cm in size and pointed tip. The base is closely attached to its stem and the edges are flat. Flowers come out of the armpit of the leaves and the ends of the branches, in the form of grains. The grain is in the form of a stone fruit and oval in shape. The variety of Mayuen has a white/blue-purple and hard-skinned grains when grow old. The type of grains that cultivated is soft and can be made porridge, while the wild type is hard and can be used for beads of the necklace.
This plant is rare in West Java and farmers still cultivate it in conventional way. It can be found only in several Districts, such as Bandung, Cipongkor, Gunung Halu, Kiarapayung, Rancakalong, Tanjungsari, Sumedang, Sukabumi, Garut, Ciamis and Indramayu. Local people are used to enjoying these hanjeli products as porridge, "tape", lunkhead and etc. However, the process to unskin the grains is rather difficult because they are relatively smaller in size than sorghum and wheat. Hanjeli plants grow from seeds. It is one of the early maturing plants, which only need 135–151 days to be mature. The height is approximately between 130–182 cm. If 2 grains were planted in one hole, then in one clump of hanjeli will grow around 7–10 buds in the first harvest period. During the second harvest there will be more. Hanjeli is able to produce 2–3 tons/ha unskinned grains. Harvest index is 0.3–0.4 and yield of skin broken grain is 43%. Hanjeli starch granules are round and polygonal with an average size of 11.68–12.29 µm. The gelatinization temperature of white and black Hanjeli ranges from 67–81 °C, with type A gelatinization. The grain of the Mayuen variety contains nutrients that equivalent to rice, which in 100 g of grains contains 76.4% of carbohydrates, 14.1% of protein, 7.9% of vegetable fats, and 0.054% of calcium. According to Nurmala (2011) [14] and Histifarina et al (2018) [15], hanjeli nutritional value is showed by Table 1.

Table 1. Nutritional value of hanjeli plants.

| Nutrition Component | Rice | Skin Broken Hanjeli | Hanjeli Flour | Rice Hanjeli***) |
|---------------------|------|---------------------|---------------|-----------------|
| Water content       | -    | 10.0%               | 7.80          | 14.64           |
| Protein             | 11 g | 14.43%              | 4.4–9.47      | 12.99           |
| Fat                 | 4 g  | 4.31%               | 4.2–9.1       | 0.25            |
| Fiber               | -    | -                   | 1.27–3.56     | -               |
| Carbohydrates       | 61 g | 71.5–80.14%         | 83.3–71.0     | 71.81           |
| Starch              | -    | -                   | 51.9–55.8     | -               |
| Ash                 | -    | 0.60–1.68           | 0.16–2.3      | 0.31            |
| Glucose             | -    | -                   | 8.14–11.4     | -               |
| Ca                  | 213  | -                   | -             | -               |
| Fosfor (mg)         | 176  | -                   | -             | -               |
| Iron (mg)           | 11   | -                   | -             | -               |
| Vitamin A (mg)      | 0    | -                   | -             | -               |
| Vitamin B1 (mg)     | 0.14 | -                   | -             | -               |
| Vitamin C (mg)      | 0    | -                   | -             | -               |
| Total Energy (kkal) | 289  | -                   | -             | 341.45          |

Source: *) [17]; **) [2]; ***) [15]

The basic nutritional content of Hanjeli is not much different from other types of cereals. However its protein, fat and vitamin B1 is higher than other cereals. Its calcium levels are higher than rice, corn and sorghum. Yulianto et al (2006) cite in Nurmala, (2011) [14] said that the protein contained in Hanjeli
grains consists of amino acids tyrosine, arginine, histidine, glutamate acid, lysine and leucine. The protein in hanjeli seeds was concentrated in the endosperm, whereas fat was plenty to be found in embryo, which in food processing will be carried out in bran fractions and dietary fiber is concentrated in the bran. Phenolic compounds that act as antioxidants found at the large quantities in the skin. Besides being rich in protein, Hanjeli seeds also contain essential fats, myristic and palmitic fatty acids. Its fatty acid consist of 45–55% essential fatty acids, 35% oleic acid, and 39% linoleic acid [16]. With this compositions, hanjeli flour can be used as raw material for brownies. The use of this flour can reduce the proportion of butter since the level of fat or oil is already high. In addition to macro nutrients, hanjeli also contains bioactive components that are beneficial to health such as essential fatty acids, phenolic compounds and dietary fiber [3].

5. Functional food components and its uses potential

The functional food component must remain on consumption food. Therefore, the physicochemical characteristics of hanjeli flour have an important part to making preferable product. As a food ingredient, some potential uses of hanjeli seeds are as a mixture of rice, or used alone as hanjeli rice, as a mixture of other cereal foods, such as oatmeal mixtures that produced by one of the leading cereal food producers in Taiwan. Hanjeli has a chewy texture but not sticky, so it has the potential to be processed into a good alternative food such as ‘tape’, porridge (with sweetness equal to green bean porridge), and as a mixture to ‘Kolak’. Hanjeli is also very potential as a medicinal plant. As an herbal medicine, hanjeli is believed to have various properties as antitumor (cancer) and urolithiasis. The source of the active ingredient of the drug is obtained from both the seeds and extracts of the roots. Efficacy as an antitumor has been scientifically studied. The active substance in hanjeli is called coixenolide [13]. Bioactive components in hanjeli are good for diabetics and autists. Hanjeli seed extract is good for health which has a function as a urolithiasis, decreased accumulation of liver fat, anti-tumor and anti-cancer, protects against viral infections, reduces allergic reactions, ward off free radicals, lowers high blood pressure, urine peluruh, decreased arterial disease coronary and artherosclerosis and decreased osteoporosis [18].

Hanjeli in the form of rice and flour has a wider use of foodstuffs. Syahputri and Wardani (2015) [19] said that hanjeli flour can be used as an alternative substitutes or substituents of wheat flour for cookies and fresh bread products as one way to reduce the use of wheat flour in Indonesia. The weakness of cookies made from Hanjeli flour are in their hard and sandy texture. The Use of hanjeli flour to substitute wheat flour for tasteless bread also produces a hard texture. Nurwala (2011) [14], reported that hanjeli flour can support a variety of industries, both small, medium and large high-tech industries, and is even expected to provide more benefits for the food industry and even the pharmaceutical industry. This is considering that the treatment using hanjeli seeds has been carried out for generations for many years.

Nurul (2016) [2°] says that a mixture of 30% hanjeli flour and 70% wheat flour can produce bread that has good taste, while making crispy cookies is produced using a composition of 35% hanjeli flour, 5% flour, 32% margarine, 8% eggs, 15% powdered sugar, 4.8% milk powder and 0.2% baking powder. Hanjeli flour contains high calcium, in 1 portion of hanjeli cookies has a calcium content of 155 mg. The results of organoleptic properties on color, taste, aroma and texture show cookies with 50% hanjeli flour and 50% wheat flour are the best cookies [20]. While it was reported that natural starch found in hanjeli seeds has several deficiencies, which require a long time in processing, the formed paste is sticky and cannot resist acidic treatment [14].

6. Conclusion

Hanjeli has the potential as a functional food because it has a high carbohydrate content and is rich in calcium, protein, dietary fiber, essential fatty acids, myristic and palmitic fatty acids. Hanjeli has a lot of benefits for health such as urolithiasis, antitumor (cancer), anti-tumor, suppress allergies, protect against viral infections, ward off free radicals, decrease coronary artery disease and artherosclerosis and decrease osteoporosis. Hanjeli also contain bioactive elements so it is very good for diabetics and autist. The superiority of hanjeli is expected to be able to change the image of hanjeli into functional
food with high nutritional value and can be used as a healthy food, so that finally it can support food sovereignty.

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