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REVIEW ARTICLE

Canna (Canna edulis) Flour's Properties as Indonesian Functional Food to Lower Colorectal Cancer Risk

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A B S T R A C T

The imbalanced food supply in Indonesia has posed a significant challenge. The utilization of canna (*Canna Edulis*) starch can act as a potential solution, enabling society to consume a more diverse variety of commodities rather than relying solely on rice. Canna, an underutilized tuber, is rich in resistant starch and bioactive compounds, showing potential in tackling dietary and health issues. Despite its high glycemic index, efforts to modify canna starch into resistant starch aim to enhance its health benefits by improving blood sugar control and gut health. This paper aims to introduce ganyong (*Canna edulis*) starch as a versatile alternative to rice or wheat for carbohydrates, which also highlights the urgent need to address and prevent the high prevalence of colorectal cancer in society by the role of bioactivity and mechanisms of action of canna starch. The applications of canna starch in the food industry, such as ginger *bangket* biscuits, cendol, and cookies, are discussed to highlight its potential as a substitute for traditional starch sources, along with its sensory attributes. The results of these applications showed a p-value of >0.05, indicating there were no significant differences in using canna starch as an alternative to other flours. Although limitations are acknowledged, continued research and development in processing techniques are essential to unlock the full potential of canna starch and its application in addressing food security and health challenges.

K E Y W O R D S

Canna Starch, Canna Edulis, Colorectal Cancer, Health - Benefits

H I G H L I G H T S

- *Canna edulis* is a locally grown tuber found in Indonesia
- There are multiple health benefits of canna starch, especially towards colorectal cancer
- Canna starch have been applied widely in Indonesia as food products with acceptable sensory
- There are several limitations but also several new innovations which can be the future of canna starch

INTRODUCTION

One of the prevalent challenges faced by developing countries, including Indonesia, is the uncontrolled growth of the population coupled with an imbalanced food supply from farmers. Efforts have been made to optimize the utilization of various agricultural products, enabling society to consume a more diverse array of commodities rather than relying solely on one specific staple, such as rice. Moreover, Indonesia possesses significant potential in the production of natural cereals, legumes, and tubers, which should be utilized judiciously. Tubers represent an alternative source of carbohydrates derived from staple foods. A study by Mursilati et al. (2021), canna or ganyong (*Canna edulis*) is one such tuber that remains underutilized. This herbaceous plant thrives abundantly in tropical areas and grows wild in yards or forests. *Canna edulis* from the *Cannaceae* family, an herbaceous plant belonging to the tuber family, serves both as a food source and an industrial raw material. Renowned for its high yield and drought tolerance, *Canna edulis* demonstrates efficient nitrogen utilization (Nugraheni et al., 2018). Efforts to promote the cultivation and utilization of ganyong could contribute significantly to addressing food security challenges and promoting agricultural sustainability in Indonesia.

According to the Indonesian Ministry of Agriculture (2023), the production of edible canna in Indonesia has reached levels of 40 – 60 tons per hectare within 8 months of harvest age. Meanwhile, compared to cassava, it acquired an average 21.52 tons/Ha with 10-18 harvest age (Gabriel et al., 2021 & Agriculture and Food Security Agency of Banyumas Regency, 2024). As mentioned by Patricia et al. (2021), edible canna rhizomes contain starch levels ranging from 73.5% to 85.5%, with amylose content typically falling between 21% and 31%. In comparison, these numbers are almost similar with rice that has 80% starch with up to 15% amylose content and wheat that has 65-75% starch with 25% amylose content (Chen et al., 2016, Zhang et al., 2019 & Wang et al., 2021). Moreover, the starch contained in canna belongs to resistant starch (RS), which is a form of starch that resists digestion in the digestive system (Butardo & Sreenivasulu, 2016). The indigestibility and water solubility of RS preserves their palatability and mouthfeel, making them behave like soluble fiber. Resistant starches are a valuable class that provides the benefits of fiber while maintaining sensory attributes (Mudgil, 2017).

Despite the fact that the cultivation and utilization of this tuber are not widely popular, the consumption of canna has a long history, with traditional methods including boiling, grilling, frying, or its use as a condiment in vegetable dishes. Moreover, canna (ganyong) possesses high carbohydrate content and is favorably embraced by Indonesians as an alternative to rice due to its distinctive aroma and taste. Variations in its use are also observed in other countries such as South America, Thailand, China, Taiwan, and Vietnam, where *Canna edulis Ker Gawl* is predominantly grown. Although lacking scientific validation, *C. edulis* rhizomes have traditionally been utilized in Vietnam to produce their famous transparent starch noodles and as medicine for treating and preventing heart-related conditions (Vu & Le, 2019). Therefore, enhancing canna starch modification is critically required to improve its qualities and broaden its potential applications.

The alteration of lifestyle in the massive population toward modernization entails a propensity for consuming food that is high in fat with insufficient fiber intake. This lifestyle pattern has been reported to contribute to several health problems, particularly affecting the colon as a vital part of the digestive system. Colorectal cancer (CRC) represents one of the severe stages of colon-related conditions that can arise from poor dietary habits. The prevalence of colorectal cancer in 2020 was estimated at around 1.9 million worldwide, resulting in 0.9 million deaths (Xi & Xu, 2021). Furthermore, the current study mentioned the young age group 20 – 29 was reported to have the highest increase of CRC cases per year (7.9%), followed by the age group 30-39 years (3.4%), and 40-49 show the least increase in colon cancer over years (1.6%) (Vuik et al., 2019). According to Purnomo et al. (2023), CRC constitutes a major public health concern in

Indonesia, ranking among the top three cancers with the highest mortality rates. However, this rate is highly dependent on which stage the cancer is found, and the earlier it is the better the prognosis it gives.

The treatment of this cancer typically entails high costs, and the chances of recovery are relatively small. Thus, preventive measures should be implemented as early as possible. Edible canna is known to be rich in polyphenolic compounds that have been linked to high levels of antioxidant activity and radical scavenging activity. It has also been demonstrated that the plant has a chemopreventive effect that reduces the risk of colorectal carcinogenesis because of its high calcium and dietary fiber content, which act as anti-proliferative agents (Praseptiangga et al., 2022). In addition, Burhannudin et al. (2018) discovered that calcium and dietary fiber in edible canna serve as antiproliferative agents by decreasing or inhibiting the expression of mutant adenomatous polyposis coli (APC).

Apart from preventing colorectal cancer, research has demonstrated that *Canna edulis*, as a carbohydrate source, can regulate the glucose and lipid profile in individuals or animals with diabetes mellitus (Nugraheni et al., 2017). Based on a research that was done by Miao et al. (2024), the authors gave type 3 resistant starch extracted from *Canna edulis* to 115 panelist and found it has many positive impacts, including reducing the blood glucose and lipid levels mediated by intestinal flora regulation and metabolism of amino acid by consuming it. Tanaka et al. (2023) have classified *Canna edulis* as both a prebiotic and an immune function regulator. This is because consuming a high amount of this starch can lead to a significant increase in n-butyric acid, lactic acid, acetic acid, and *Clostridium* subcluster XIVa in the cecal contents.

This paper aims to introduce the society to canna (*Canna edulis*) starch, which can be utilized in various ways to replace rice or wheat as a carbohydrate source. Additionally, the study aims to raise awareness among the public regarding the current high prevalence of colorectal cancer, which should be addressed and prevented as soon as possible.

CANNA STARCH PROPERTIES

Bioactive compounds of canna starch

Canna starch, with its high carbohydrate content of approximately 89.43%, serves as a significant source of energy for the human body (Herawati et al., 2017). This high carbohydrate profile emphasizes its utility in a variety of dietary situations, providing a sustainable supply of fuel for metabolic functions. Beyond its role as a carbohydrate source, canna starch contains a variety of bioactive compounds that contribute to its possible health advantages. Research indicates that canna starch contains amylose and amylopectin in the ranges of 21.14 to 24.44% and 75.56 to 78.86%, respectively (Sedyadi & Yuliati, 2020). However, its relatively low amylose content renders it unsuitable as a complete replacement for flour in certain food industry applications (Handajani et al., 2019). Despite this limitation, canna starch comprises minor constituents such as protein (3.13%), fat (1.53%), ash (0.39%), and moisture (3.8%), with a total fiber content of 1.72% (Harmayani et al., 2012). In addition, canna starch also contains a significant amount of dietary fiber which plays a crucial role in promoting digestive health, enhancing satiety, regulating bowel movements, and fostering overall gastrointestinal well-being. Insoluble dietary fiber content in canna starch ranges from 3.2-3.6%, meanwhile the soluble dietary fiber content is 4.98%. This makes the total dietary fiber contained in canna starch ranging from 8.19 to 8.59% (Carolina & Ilmi, 2016). Furthermore, canna starch also has a high water binding capacity (162.15%), which is likely attributed to its high phosphorus content, big granule size, and significant number of hydrogen bonds produced between water and the extremely long branch chains of amylopectin. As a consequence, canna starch also had a high swelling power (Aprianita et al., 2014). These characteristics contribute to its diverse food industry applications and textural attributes in food product formulations. In addition to its macronutrient and fiber content, canna starch contains a trace amount of phytochemicals such as flavonoids, polyphenols, proanthocyanidins, and alkaloids. Despite the low levels of phytochemicals contained, all of which are still linked to potential health benefits, including stomach protection from conditions such as peptic ulcers (Najini et al., 2018). Canna starch contains antioxidants such as saponins, triterpenoids, and steroids, but its overall antioxidant activity is considered rather low (Hasri, 2016). Despite this, its complex nutritional profile and bioactive ingredients emphasize its potential as a functional ingredient with a wide range of health benefits.

The glycemic index determines how rapidly carbohydrates in a specific food elevate blood sugar levels when compared to pure glucose, serving as a crucial parameter in understanding dietary effects on glucose metabolism (Rytz et al., 2019). Despite the importance of this index in determining food's glycemic impact, there is a noticeable lack of particular data on the glycemic index of canna starch. However, it's found that canna starch possesses a relatively moderate glycemic index (GI = 65), which might need processing procedures to reduce its glycemic index (Yovani et al., 2022). For example, using the autoclaving-cooling method that alters the starch into RS, it is able to reduce canna starch glycemic index caused by reduction of 9,38% water and 74,25% carbohydrate content (Putri & Dyna, 2019). Additionally, this alterization could be done by fermentation procedures that are also able to reduce its glycemic index content and improve its nutritional profile (Rakhmawati et al., 2022). Modified canna starch has a considerable quantity of resistant starch, which resists digestion in the small intestine and functions as a prebiotic or substrate for bacterial fermentation in the large intestine (Rosidah et al., 2013). The addition of resistant starch in the diet has been related with several health benefits, including the promotion of healthy gut bacteria, enhanced digestive function, and possible management of blood cholesterol levels (Histifarina et al., 2023). Specifically, canna starch-derived resistant starch predominantly belongs to the category of resistant starch type III (RS3), also termed retrograded amylose, which forms through the gelatinization and subsequent retrogradation of native starch granules. This specific structural change makes resistant starch less vulnerable to enzymatic breakdown, extending the release of glucose into the bloodstream and providing a hypoglycemic effect on blood glucose homeostasis.

In comparison to white rice, canna has a larger composition of non-available carbs, encompassing a broad array of resistant starch and fiber content. The resistant starch in canna starch ranged from 10% to 25%, while white rice only varied between 0.5% to 2% (Afandi et al., 2019). These non-available carbohydrates found in canna starch, including various forms of modified starch or resistant starch, resist enzymatic digestion and subsequent absorption throughout the gastrointestinal tract, consequently affecting postprandial metabolic responses (Lovegrove et al., 2017). Non-available carbohydrates are more complicated due to chemical changes, processing processes, or interactions with other dietary components, resulting in a wide range of physicochemical features and physiological impacts. Furthermore, the unique composition of non-available carbohydrates in canna provides a valuable route for dietary modification aimed at optimizing metabolic health outcomes.

Digestibility of canna starch

Starch digestibility measures the accessibility of the starch and measures the ability of starch to be hydrolyzed by breaking enzymes to produce smaller molecules which can be absorbed by the body (Carolina & Ilmi, 2016). A study by Koida et al. (2024) mentioned that canna starch has a relatively low digestion, which is only about 53%. Whereas, compared to rice starch, which is up to 75.7% digestibility (Toutonji et al., 2019). Canna starch differs from other starches as it has larger oblong granules, a higher amylose content, and a higher thermal resistance to viscosity breakdown. As a result of their greater surface area per unit weight, starch grains with a smaller diameter are generally easier for enzymes to break down. Due to high-amylose starch exhibiting a strong resistance towards gelatinization at temperatures higher than 120°C, it is possible that the low digestibility of canna starch is connected to the high amylose content of its resistance starch (Tanaka et al., 2023).

Canna starch metabolism in gastrointestinal tract

According to Bojarczuk et al. (2022), various studies suggest that both resistant starch and dietary fiber yield short chain fatty acids (SCFA) as metabolites, decrease colonic pH, reduce intestinal transit time, and increase fecal bulk. When resistant starch escapes digestion, it becomes a significant proportion of the carbohydrates that will be metabolized by bacteria in the colon. During fermentation by microorganisms in the colon, undigested carbohydrates produce SCFA, such as acetate, propionate, and butyrate, thereby reducing colonic pH. Through two metabolic routes, butyrate is produced from dietary fibers through bacterial fermentation. In the first pathway, butyryl-CoA undergoes phosphorylation to generate butyryl-phosphate, which is then converted to butyrate by butyrate kinase (Louis & Flint, 2017). In the second pathway, the CoA moiety of butyryl-CoA is transferred to acetate via butyryl-CoA: acetate CoA-transferase, leading to the formation of butyrate and acetyl-CoA (Trachsel et al., 2016).

Canna starch is often favored by those with digestive sensitivities, as it is gluten-free and generally easy to digest. It's considered a suitable alternative to wheat flour for individuals with gluten intolerance or celiac disease (Aprianita, 2010; Histifarina et al., 2023; Malki et al., 2023). Compared to dietary fiber, resistant starch generates a higher proportion of butyrate, which is believed to be associated with good colonic health. Canna starch is not commonly associated with allergies. Furthermore, there is a lack of scientific data indicating that canna starch can cause allergic reactions. However, individuals who have allergies to other types of root vegetables or tubers should have caution and may wish to seek advice from a healthcare professional before incorporating canna starch into their diet.

Canna starch is generally considered safe for consumption (FDA, 2015). It's a naturally occurring substance originating from the canna plant (*Canna edulis*) and is commonly used as a thickening agent in cooking and baking. According to the FDA, no adverse effects have been attributed to these starches as added food ingredients (Budiarsih, 2010). However, consumption of excessive quantities, pounds per day, of raw starch has resulted in obesity and iron-deficiency anemia in human subjects (FDA, 2015).

Canna tubers extraction

The extraction of canna tubers involves an intricate set of procedures that are carefully carried out to guarantee both the purity and the quality of the end product. The first stage begins with the process of crushing and soaking the raw substance, during which the canna roots are broken down and immersed in water for a specific period of time to promote the release of starch granules. Soaking for four to twenty-four hours needs to be done to extract starch from the plant material as effectively as possible (Juansang et al., 2015). Subsequently, the liquid is subjected to a thorough filtration and concentration procedure, during which solid particles are carefully eliminated, and the liquid containing starch is condensed to augment the concentration of starch. Afterwards, the concentrated starch solution is added to an alkaline solution such as sodium hydroxide (NaOH) that can help to enhance the extraction process and aid in separating starch from other mixture components (Dorantes-Fuertes et al., 2024). The extraction process is carried out meticulously to guarantee the highest possible yield and purity of the extracted starch. Eventually, the starch that has been extracted undergoes an intensive drying procedure, during which any remaining moisture is eliminated to acquire the ultimate starch product in its powdered state, which is prepared for usage in many industrial and culinary contexts. Every stage of this complex procedure is precisely coordinated to guarantee the manufacturing of Canna Starch of superior quality, adhering to strict standards of both potency and purity (Sedyadi & Yuliati, 2020).

Bioactivity and mechanism of actions

Canna edulis is rich in calcium and fiber, which makes it has the ability to reduce colorectal cancer risk (Haggar & Boushey, 2014). The dietary fiber is able to create a protective effect against colorectal cancer (CRC) by increasing fecal bulking, reducing inflammation, and shortening the contact time between the carcinogenic agent and the gut cells. Meanwhile, the calcium will reduce inflammation, β-catenin as well as increase the E-cadherin, MutL Homolog 1 (MLH1) and MutS Homolog 2 (MLH2) expression in the gut (Yang et al., 2014). Therefore, this benefit is proven by the research that was done by Burhannudin et al., (2018), in which they created an experiment towards thirty male Wistar rats and treated them with different concentrations of canna. The treatment is done for 14 weeks and the expression of Adenomatous Polyposis Coli (APC) and Nitric Oxide Synthase (iNOS) is observed.

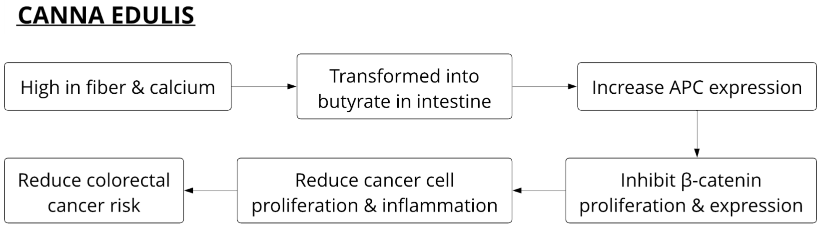

Figure 1. The mechanism by which *Canna edulis* reduces colorectal cancer (CRC).

The expression of these two compounds are observed due to the digestion process, the dietary fiber will be transformed into butyrate due to the fermentation that acts as a histone deacetylase inhibitor agent (HDACi), whereas this mechanism will reduce proliferation and β-catenin expression, while also increasing the Adenomatous Polyposis Coli (APC). Therefore, Azoxymethane (AOM) is a carcinogenic compound and APC is known to be able to inhibit β-catenin that reduces cell proliferation that may occur by AOM and iNOS will act as an inflammatory agent. Thus, the detection of these two compounds means that fiber and calcium work to reduce the risk of cancer. Therefore, based on their research, a significant difference was found in the group that was treated with 10% of canna (the highest concentration among samples), whereas they have the lowest CRC risk due to high calcium and dietary fiber intake. **Figure 1** shows the overall mechanism of which *Canna edulis* reduces colorectal cancer.

SAFETY OF CANNA STARCH

Tolerable dose for canna starch

Although *Canna edulis* is considered a simple food, it may cause hostility towards people with several health conditions, such as carbohydrate and starch intolerance, whereas they are unable to digest the carbohydrate due to a lack of intestinal enzymes or too much resistant starch consumption that is unable to be digested. Therefore, this undigested carbohydrate and starch will lead to the gut bacteria overgrowth and influence flatulence, abdominal cramps as well as pain, diarrhea, and sometimes even headache that in fact, has been associated as one of the source of the non-specific abdominal complaints that has been reported happened on 30% of the population (Born, 2014). In addition, *Canna edulis* is high in starch resistant rate compared to the other starches with a total up to 1.45±0.24 % from total weight. Thus, it is recommended only to consume 5 grams per day of resistant starch, much less than the minimum of 6 grams per meal to gain the health benefit instead of its side effect due to the overconsumption (Birt et al., 2014).

Regulation and Labeling

The regulation and labeling of canna starch must adhere to BPOM standards, which require P-IRT numbers. BPOM guidelines ensure safety, quality, nutrition, and labeling of processed foods, including specifications for food additives, contamination limits, auxiliary material usage, claims, and nutritional information. The labeling of canna starch in food products should include the product name, brand, net weight, health department permit, production address, nutritional composition, expiration and production dates, nutritional information, and any potential allergens or other relevant information required by food labeling laws. Compliance with these regulations guarantees consumer safety and informed choices regarding canna starch-containing products (BPOM, 2018).

APPLICATION OF CANNA STARCH IN FOOD

Impacts of canna starch in cookies

In the experiment conducted by Nugraheni et al. (2019), the development of cookies enriched with *Canna edulis* flour, the varying amounts of this flour had a significant impact on the cookies' sensory, chemical, and physical properties. The formulation used in this experiment was based on the changes in the amount of *Canna edulis* flour rich in RS3 to the total flour gluten-free, FI using 10.5%, FII using 12.5%, and FIII using 14.5%.

Increasing the proportion of *Canna edulis* flour generally enhances the texture by adding a firmer, more cohesive structure due to its highly resistant starch (RS3) content. This also affected the spread ratio and hardness, with higher amounts of the flour reducing cookie spread and increasing its hardness.
From an organoleptic standpoint, increasing the *Canna edulis* flour made the cookies more acceptable in terms of taste and texture, as resistant starch enhances moisture retention and provides a pleasant mouthfeel. However, if the amount of *Canna edulis* flour was too high (FIII with 14.5% *Canna edulis*), it could result in overly hard cookies with diminished flavor due to reduced fat content from replacing wheat flour. The formulation adjustments also influenced the chemical composition of the cookies. More *Canna edulis* flour increased fiber and resistant starch content while lowering the protein and fat, making the cookies healthier but potentially less indulgent. A moderate amount of this flour (FI with 10.5%) optimized the balance between a healthier nutritional profile and maintaining a pleasant sensory experience. Physically, as *Canna edulis* flour levels increased, the cookies showed reduced diameter and height, as the resistant starch reduced dough elasticity. This resulted in cookies with less spread but a denser, more compact structure. The hardness of the cookies increased correspondingly, meaning they became crisper and less soft when more *Canna edulis* was added.

In conclusion, careful optimization of the *Canna edulis* flour ratio in the formulation is crucial to maintaining a balance between functional benefits and desirable sensory characteristics. The flour's resistant starch enhances texture, nutritional value, and gut health properties, making the cookies both functional and enjoyable when formulated correctly.

Impacts of canna starch in ginger bangket biscuits

Wuryanto & Ilminingtyas (2022) investigated the properties of canna starch by using it to make *ginger bangket* biscuits. There are four categories of canna starch substitution composition, ranging from 0% to 100%. Organoleptic and sensory qualities were taken into consideration when analyzing the biscuits. The percentages of water, ash, protein, fat, carbohydrate, and fiber content made up the organoleptic measurements. The results of the study confirmed that the organoleptic characteristics of each sample did not significantly differ from one another. Regarding the sensory attributes, including taste, aroma, texture, and color, each received a rating that is categorized as slightly or moderate. The results from the ANOVA test show the p value of 0.8, 0.792, 0.797, and 0.7 for the taste, color, aroma, and texture, respectively, which is above 0.05 indicating that there was no significant difference in the processing of ginger bangket cookies when canna starch was substituted for sago starch. Consequently, it was feasible to produce *ginger bangket* cookies using canna starch instead of sago starch.

LIMITATIONS AND RECOMMENDATIONS FOR CANNA STARCH

Limitations

Innovation in technology has greatly expanded the range and effectiveness of processing methods used to manufacture different products, such as starch. The technology of enzymatic hydrolysis is widely recognized in this field, providing a means to degrade starch into less complex forms. According to Purwitasari et al. (2023), the present processing method comprises the use of thermostable α-amylase and glucoamylase enzymes. These enzymes facilitate the hydrolysis of starch, leading to the creation of a decreased molecular structure. According to Longas and Diaz (2020), a variety of modification technologies have been suggested to improve various characteristics of canna starch, including physical, chemical, and genetic modification. One potential method for modifying the characteristics of canna starch is by physical modification, such as the application of ultrasonic microwave treatment. According to Yılmaz and Tugrul (2023), this particular procedure entails a very low level and duration of processing, although it has the potential to bring about substantial alterations in the properties and makeup of the starch.

Chemical modification presents as an alternative methodology, wherein starch is subjected to diverse chemical reactions to induce alterations. Chemical reactions such as acid hydrolysis and esterification can be utilized to modify the characteristics of canna starch, enabling its adaptation to specific applications (Naowarojna et al., 2021). Despite these improvements, the extraction of starch from canna plants poses various obstacles. Canna plants, specifically, are recognized for their limited capacity to withstand heat. In order to tackle this matter, researchers are utilizing genetic modification methodologies to improve heat stability and enhance the overall stability properties of the starch being produced (Bhatt et al., 2022). Enzymatic hydrolysis, along with physical, chemical, and genetic modifications, offers a comprehensive strategy to improve the production and characteristics of canna starch. The aforementioned technologies possess the capacity to overcome current limitations and unveil innovative possibilities for the commercialization of canna starch across various sectors and purposes.

Future outlooks

As mentioned before, canna starch remained to be a product with numerous possibilities of development in the future. The benefits obtained from the component canna starch are diverse, making it a valuable resource in multiple applications. A significant benefit can be attributed to the availability of phenolic compounds in this component, which are widely recognized for their strong antioxidant characteristics. Phenolic chemicals are of significant importance in the process of scavenging free radicals and improving oxidative stress regulation in the human body (Rudrapal et al., 2022). Some of these beneficial effects would also include improving immunological function of consumers, making canna starch as a potential asset for the food industry (Tanaka et al., 2023). The observed beneficial effects not only confer advantages encouraging prospects for human well-being but also preserve the structural integrity of the component.

Furthermore, *Canna edulis* has the potential to be used as a multipurpose substitute to traditional starch sources, especially when converted into a starch product. This innovation exhibits the potential to not only satisfy the functional needs of diverse food and non-food products, but also provide improved nutritional benefits, thereby addressing the changing needs of consumers and industries (Junior & Francisco, 2020). According to Histifarina et al. (2023) due to its substantial starch content and distinctive characteristics, it offers an appealing replacement for conventional starch sources like corn, wheat, and potatoes. The conversion of *Canna edulis* into a starch product has numerous possibilities for its integration into various food items, such as baked foods, sauces, soups, and desserts. Food producers have the potential to improve the nutritional composition of their products by replacing traditional starches with *Canna edulis* starch. The plant species *Canna edulis* is recognized for its composition of vital nutrients, dietary fiber, and bioactive constituents. The integration of these advantageous constituents into food compositions has the potential to enhance the nutritional composition of the final products along with providing positive benefits for lipid, glucose and short chain fatty acid profiles, facilitating customers with a more healthy option while maintaining the desired flavor and texture (Nugraheni, et al., 2018).

In addition to the aforementioned products, potential future applications of canna starch encompass food and non-food products. For food products, this can be utilized as pasta, beverages like smoothies for enhancing physical attributes, as well as innovative sauces and soups, wherein canna starch can serve as an effective thickening agent, it can also be used in the food and pharmaceutical industries as highlighted by Tanaka et al. (2023). Canna starch also has potential use in non-food commodities, such as cosmetics products due to its high water absorption capacity and encapsulating agents for enhancement of flavor (Longas & Diaz, 2020).

CONCLUSION

Canna edulis is a locally grown tuber found in Indonesia that is high in phytochemicals and carbohydrates. These substances, particularly the calcium and dietary fiber, may have health benefits, such as reducing the incidence of colorectal cancer (CRC), a condition that was widespread in Indonesia. Moreover, canna starch exhibits great resistances to gelatinization (>120°C) and a lower rate of digestion than other starches because of its high amylose content. In the human body, the gut microbiota in the colon digest canna starch to create short chain fatty acids, including butyrate, propionate, and acetate. Canna starch has a greater butyrate content, which could be beneficial for intestinal health. Canna tuber extraction is different from other starch extraction processes in that it requires the use of an alkaline solution to improve the extraction process and aid in the separation of starch from other substances, which is then followed by drying. Additionally, consuming too much canna starch can cause diarrhea, cramping in the abdomen, and gas since it is a resistant starch that the gut flora may not be able to break down. Despite the fact that it is not very popular in Indonesia, canna starch has been used to produce cookies, cendol, and ginger bangket biscuits. When canna starch is used in all of these goods, its sensory qualities are nevertheless deemed acceptable by society. Undoubtedly, the process of producing canna starch is limited; for example, using chemical reactions may cause changes to the starch's general characteristics. Proposals have been made to ameliorate this restriction by means of genetic alteration, which would increase the starch's overall stability qualities and improve its heat stability. In order to improve canna starch popularity, it is envisaged that the application of canna starch can be applied in both food and non-food items.

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