# NARRATIVE REVIEW: ON THE HEALTH BENEFITS OF THE NUTRITIONAL CONTENT OF THE SACHA INCHI PLANT (PLUKENETIA VOLUBILIS L.) POTENSAN

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**ABSTRACT**

To improve food security and health through improving nutrition, one plant that has potential but not many people use it is sacha inchi (Plukenetia volubilis L.). All parts of the sacha inchi plant can be used by humans. The parts of sacha inchi that are beneficial for health include the seeds, leaves and oil. This part is very rich in nutrients, including protein, fiber and fat. The nutritional content of sacha inchi is influenced by the processing method and planting location. The method used in writing this article is literature study on databases in the form of PubMed, Cochrane, and Embase as well as the Google Scholar search engine with a focus on information regarding the nutritional content of Sacha inchi which has been published no later than the last 10 years. The results obtained from 10 international journals show that Sacha inchi has and is a source of nutrients that are beneficial in the health sector. This article will discuss the nutritional content of the sacha inchi plant which has the potential to be used in the health sector as a food ingredient, medicine and other products.

**Keywords:** Sacha inchi (Plukenetia volubilis L.), nutrition, benefits

## INTRODUCTION

Indonesia is a country with quite high biodiversity. Indonesia's tropical forests are home to more than 30,000 plant species. Of this number, around 9,600 species are known to have medicinal properties, but only 200 species are used as raw materials for the traditional medicine industry. Of the approximately 250,000 to 500,000 plant species in the world, it is said that only about 15% have been studied phytochemically. In contrast, in the plants tested the biological activity was only around 6%.(UGM, 2017) Although research often focuses on the most important staple crops, many other underutilized crops also have great potential to contribute to food security, including improving nutrition and health. The value of these plants may exceed staple crops, so they may be a good choice for further research. A less studied plant is sacha inchi (Plukenetia volubilis L.). Sacha inchi is a type of bean that is not grown in Indonesia. Sacha inchi beans (Plukenetia volubilis) come from the Amazon tropical forest. However, sacha inchi is now grown in China, Vietnam, Malaysia, Thailand and recently in Indonesia.

You can use different parts of the sacha inchi plant. The leaves contain antioxidants and can be consumed as a vegetable or as a tea. Fruit seeds contain unsaturated fatty acids with an omega-3 content of 47-51 percent and an omega-6 content of 34-37 percent, while olive oil only contains 1 percent omega-3 and does not include omega-9 except for the leaves and seeds. The oil extracted from sacha inchi seeds has health benefits (Kemendikbud, 2022) Due to the high quantity and quality of oil contained in sacha inchi seeds, this plant has attracted the attention of the food industry (Otálora et al., 2020)The seeds consist of a star-shaped capsule measuring about 3-5 cm, which usually contains 4-6 oval-shaped dark brown edible seeds, measuring 1.5-2 cm. (Supriyanto et al., 2022) The seeds of this plant are an excellent source of vegetable oil (41-54%). This oil contains lipids (35–60%), free fatty acids (1.2%), and phospholipids (Supriyanto et al., 2022). The high nutritional value of sacha inchi oil is due to the content of polyunsaturated fatty acids (PUFA) and monounsaturated fatty acids (MUFA), which are unsaturated fatty acids, each of which ranges between 77.5 ± 84.4% to 8.4 -13 2%.

Alpha-linolenic acid (ALA; C18:3, ω-3) was the main fatty acid (47–51%), followed by linoleic acid (LA; C18:2, ω-6, 34–37%) and Oleic acid ( ω- 9.9–10%) (Rodríguez et al., 2022). These fatty acids are considered beneficial because they contain antioxidants, antithrombotics, antidyslipidemia and anticancer (Torres-Sánchez et al., 2023) and this plant contains various ingredients that have been proven to have different benefits for human health.

Increase resilience food and health through nutrition Which more Good need effort for diversify plant Which planted and utilise plant Which potential less utilized. Plant sacha inches become supplement nutrition daily multipurpose. Besides diversification plant, fortification Also can done for increase content nutrition sacha inches on food so that increase quality pangan (Gonzalez-Aspajo et al., 2015a)

seeds, leaf, skin and shell Sacha Inch already studied benefit nutrition and bioactive. Seeds so will oil so fed up beauty, protein quality height, sour amino essential, fiber, mineral, tocopherol, phytosterols, compound phenolic, as well as own nature antioxidant, anti cancer, antihypercholesterolemia, Suitable as antihypertensive and antibacterial. The leaves contain compound phenolic and antioxidant as well as show activity Which relate with health regularly in vitro, Which show potency as source compound Which increase health. (Chasquibol et al., 2023) By-products such as skins and shells also offer valuable nutritional composition, phenolics and health benefits, making them a potential food source for the future. In addition, sacha inchi can be processed into a thick drink for the elderly, increasing its essential amino acid content and antioxidant capacity.

*Narrative review* This aims to analyze various studies that have been carried out regarding the nutritional content and benefits contained in the sacha inchi plant for humans.

## METHOD

The data collection method was carried out by literature study (*literature review*) includes reviewing data, collecting data through published related research results, and analyzing data that has been carefully selected. A literature review study was carried out by searching for the keyword "Sacha inchi (*A rolling blanket*L.)", *"Health", "Pharmacology activity"* and*"Content"*. Literature searches were carried out on databases in the form of*PubMed, Cochrane,* and*Embase* as well as*search engine Google Scholar.* The inclusion criteria used in writing this article are international articles with a publication year no later than the last 10 years in the 2015-2024 range which provides information about the nutritional content of sacha inchi for health. Meanwhile, the exclusion criteria were journals that discussed the sacha inchi plant but did not discuss nutritional content. In addition, review articles and articles with publication years less than 2015 were also excluded. The number of scientific journal sources obtained from the literature search was 10 journals that discussed the nutritional content of the sacha inchi plant (*A rolling blanket*L) based on the influence of processing and planting.

## RESULTS AND DISCUSSION

Based on a search for literary sources, a total of 66 journal articles were obtained that met the keyword criteria in the form of "Sacha inchi (*A rolling blanket*L.)*", "Health", "Pharmacology activity"* and*"Chemical content"* Then the 66 journal articles were selected based on the criteria for the included articles so that 10 journal articles were obtained that met the criteria. In this review, it will be explained that the compound content in sacha inchi can be influenced by the processing method, selection of plant parts and planting location.

Based on the criteria for included articles, the studies were characterized based on plant parts, content, total amount of content obtained, identification methods and literature sources which can be seen in Table 1. From the results of the literature study, it shows that there are many nutrients that have the potential to be utilized in the health sector because contains ingredients that can provide benefits as a source of nutrition. The benefits of sacha inchi are grouped as follows:

***Antioxidant***

Sacha inchi seeds and seed oil contain varying levels of antioxidant components, including the phenolic compounds α, β, γ, δ-tocopherol, carotenoids, and phytosterols. Another study reported an antioxidant capacity value of 32% for DPPH free radical scavenging test results and 730 µmol FeSO4 for test results*ferric reducing antioxidant power* (FRAP). This antioxidant activity can be attributed to phenolic compounds whose content ranges between 51 and 312 mg gallic acid equivalent (GAE)/100 grams (Castro et al., 2020)

The antioxidant capacity of sacha inchi (*A rolling blanket*L.) is influenced by many factors, one of which is the composition and chemical properties of the plant constituents themselves. The antioxidant activity of sacha inchi seeds is also known to be influenced by temperature. According to research (Keawkim et al., 2021), antioxidant capacity was found to decrease in seeds that were treated with low water activity (eg high temperature and roasting) compared to seeds that underwent vacuum boiling. Changes in the antioxidant capacity (DPPH or ORAC value) of sacha inchi seeds are related to changes in the content/composition of tocopherols and phenolics brought about by thermal processing.

***Anti-inflammatory***

Sacha inchi (*A rolling blanket*L.) can work as an anti-inflammatory from the various compounds it contains such as phenolic compounds and proteins. Based on research that has been conducted, sacha inchi is known for being rich in phenolic content, which includes various important compounds such as phenols, isocoumarins, lignans and flavonoids. This phenolic content has various health benefits, including antioxidant, anti-inflammatory and heart health (Herman et al., 2020a) Flavonoids are a group of phytochemical compounds found in various types of plants, including sacha inchi. Flavonoids have anti-inflammatory properties, which can help reduce inflammation in the body. This may be beneficial for reducing the risk of chronic inflammatory diseases, such as arthritis and heart disease. (Silalahi, 2022)

***Antibacterial***

Seeds of the sacha inchi plant (*A rolling blanket*L.) contains volatile compounds, especially essential oils from the triterpenoid group which have antibacterial activity.

Oil from sacha inchi has been shown to have activity against*multidrug resistant* (MDR) *Acinetobacter baumannii* which has been isolated clinically so that it has the potential to develop complementary and alternative medicine to combat antimicrobial resistance in MDR*A.baumannii*(Marina Silalahi, 2022)

The results of other research conducted show that the use of sacha inchi oil (*A rolling blanket*s L.) on the skin is safe and efficient in inhibiting the attachment of Staphylococcus aureus bacteria. Sacha inchi oil has been proven to prevent adhesions*S. aureus*into keratinocytes and efficiently separate them*S. aureus*from human skin explants. (Gonzalez-Aspajo et al., 2015b)

### *Antidiabetic*

Sacha inchi (*A rolling blanket*L.) has inhibitory activity against several key diabetes enzymes, namely alpha-amylase and alpha-glucosidase (scholar (20)). Based on research that has been conducted, the sacha inchi plant can improve symptoms of hyperglycemia and provide antidiabetic activity related to improving structural disorders of intestinal microbes and enriching functional bacteria such as increasing *Akkermansia, Parabacteroides,* and *Muribaculum* as well as decline *Ruminiclostridium* and *Oscillibacter* (Edwin et al., 2016a)

The phytosterol content (beta-sitosterol and stigmasterol) in sacha inchi is also stated to have inhibitory activity against alpha-amylase through studies*alive*in mice hyperglycemia induced using streptozotocin (STZ). Phytosterols in sacha inchi have been proven to induce insulin uptake from pancreatic alpha cells (Heianza et al., 2019)

### *Nutrition Source*

The development of foods with high protein, fiber and essential fatty acids or triglycerides is a trend that is used as an alternative to the needs of the current population, especially in certain consumer groups such as vegetarians, people with deficient fiber intake, and consumers who are on a diet. Due to its high nutritional value, especially as a source of carbohydrates or sugars, amino acids and triglycerides, the seeds of the sacha inchi plant are suitable for enriching food with protein, fiber and the essential fatty acids ω-3 and ω-6 (Rawdkuen et al., 2016)

Table. 1. Nutritional analysis of sacha inchi (*Plukenetia volubilis*) on health benefits

| Author, Title, Journal | Part Of a Plant | Method Design | Results |
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| Supriyanto, Supriyanto., Zulhamsyah, Imran., Rhomi, Ardiansyah., Brian, Auliyai., Adi, Surya, Pratama., F., Kadha. (2022). The Effect of Cultivation Conditions on Sacha Inchi (Plukenetia volubilis L.) Seed Production and Oil Quality (Omega 3, 6, 9). Agronomy, doi: 10.3390/agronomy12030636 (Supriyanto et al., 2022) | Leaf | Experimental Design | This study investigated and compared the phenolic composition, antioxidant potential and in vitro health-related properties of young and mature sacha inchi leaves after freeze-drying and oven-drying processes. The results showed that p-coumaric acid, 4-hydroxybenzoic acid, ferulic acid, and gallic acid were mostly detected in young leaves and mature leaves which also showed similar total phenolic content (TPC), while higher TPC was detected in dry leaves. frozen than in the oven. -dried leaves. Mature leaves showed higher antioxidant potential than young leaves after freeze-drying, whereas the opposite results were observed with oven-drying. Overall in vitro health-related activities were higher in mature leaves than in young leaves, regardless of the drying process. The knowledge gained from this research can be used to encourage prospects for utilizing sacha inchi leaves as a source of health-promoting compounds. This, in turn, will increase the commercial value of sacha inchi leaves and provide a wider market variety for sacha inchi products. |
| Suwapat, Kittibunchakul., Chatrapa, Hudthagosol., Promluck, Sanporkha., Suwimol, Sapwarobol., Piya, Temviriyanukul., Uthaiwan, Suttisansanee. (2022). Evaluation of Sacha Inchi (Plukenetia volubilis L.) By-Products as Valuable and Sustainable Sources of Health | husks and shells | Experiment | This study assessed the nutritional, antioxidant, phenolic, and health-related in vitro activities of sacha inchi husks and shells investigated and compared to increase their economic potential as a future food source. Higher protein, carbohydrate and total dietary fiber contents were detected in the husks, while higher fat and energy contents were found in the shells. Some phenolics were also detected in the husks and shells, |

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| Benefits. Horticulturae, doi: 10.3390/horticulturae8040344 (Kittibunchakul et al., 2022) | | | with p-coumaric acid being the most abundant phenolic in the shells and caffeic acid in the husks. The total phenolic content in the shell is 1.6-fold greater than in the husk, resulting in 1.8–2.7-fold higher antioxidant activity and 1.2-fold higher anti-glycation activity. |
| Kannika, Keawkim., Yaowapa, Lorjaroenphon., Kanithaporn, Vangnai., Kriskamol, Na, Jom. (2021). Metabolite-Flavor Profile, Phenolic Content, and Antioxidant Activity Changes in Sacha Inchi (Plukenetia volubilis L.) Seeds During Germination.. Foods, 10(10):2476-. doi: 10.3390/FOODS10102476 (Keawkim et al., 2021) | Seeds | GC-FID<br>GC-MS<br>FAME | This study identified 63 metabolites, including 18 fatty acid methyl esters (FAMEs) in sacha inchi seeds, with FAMEs having the highest concentrations in ungerminated seeds. The germination process of sacha inchi seeds causes an increase in amino acids, total phenolic compounds (PIC) and antioxidant activity associated with health benefits. Germination improves nutritional quality, with increases in amino acids, total phenolic compounds and antioxidant activity |
| Edwin, Darius, Betancur-Holes., Light, Shelter, Urango-Marchena., Luis, Fernando, Restrepo-Betancur. (2016). Effect of adding sacha inchi (Plukenetia volubilis L.) seeds to a prototype convenience food draft, on the nutritional composition and sensory acceptance. Journal of Medicinal Plants Research, doi:10.5897/JMPR2016.6064 (Edwin et al., 2016) | Seeds | Completely randomized experimental design | This research aims to evaluate the influence of Sacha Inchi (Plukenetia volubilis L) on convenience food prototypes. Nutrient composition and sensory acceptability were evaluated using a completely randomized experimental design. Factorial multiple correspondence analysis with fixed and balanced effects was used for the different treatments.It was observed that the lipid content increased up to 3-fold and the polyunsaturated fatty acid content increased 4-fold in the F10 treatment compared with white F0. Approximately 10% of Sacha Inchi almonds can be effectively incorporated into a designed product with appropriate time-sensitive characteristics and nutritional value, thus allowing the food to be declared |

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| | | | under Colombian law as a high and good source of omega 3. |
| Sutharut, Jiapong., Khanitta, Ruttarattanamongkol. (2021). Development of direct expanded high protein snack products fortified with sacha inchi seed meal. The Journal of Microbiology, Biotechnology and Food Sciences, 10(4):680-684. doi: 10.15414/JMBFS.2021.10.4.680-684 (Jiapong & Ruttarattanamongkol, 2021) | Flour | AOAC<br>Hedonic scaling test<br>ANOVA | The content of Sacha inchi seed flour has a significant effect on the physical characteristics by increasing the hardness and density of snack products. The expansion ratio and WAI of snack products decrease with increasing levels of Sacha inchi seed flour. The results of the sensory evaluation show that all snack formulations are generally accepted by consumers. Fortified with 40% Sacha inchi seed flour is the most acceptable product based on overall characteristics. |
| Nancy, A., Chasquibol., R., Alarcón., B., F., Gonzales., Axel, Sotelo., Lourdes, Landoni., Gabriela, Gallardo., Bethlehem, Garcia., Maria, del, Carmen, Perez -Road. (2022). Design of Functional Powdered Beverages Containing Co-Microcapsules of Sacha Inchi P. huayllabambana Oil and Antioxidant Extracts of Camu Camu and Mango Skins. Antioxidants, doi: 10.3390/antiox11081420 (Chasquibol et al., 2022) | Flour | GIFT<br>SPC<br>PEE | In this study, assessing the physicochemical characteristics of microcapsules, such as particle size, morphology, and moisture, as well as encapsulation efficiency, fatty acid composition, and oxidative stability, were determined to select the best formulation for the design of functional powdered beverages<br>The functional powder drink containing co-microcapsules of sacha inchi P. huayllabambana oil offers high ω3 content (52.74%) and antioxidant activity (324.80 mg AAE/100 g powder), enhancing health benefits |
| C., Herman., D., R., Pompeu., David, Campos., Yvan, Larondelle., Hervé, Rogez., Vincent, Baeten. (2020). Monitoring of the oxidation of the oil from sacha inchi ( Plukenetia volubilis ) seeds supplemented with | Oil | NHE<br>AOCS Cg 5-97, | This research focuses on the characterization of oil oxidation from sacha inchi seeds (Plukenetia volubilis) under accelerated conditions at a temperature of 60 oC for 15 days. Five samples were monitored: three were supplemented with 200 ppm of unhydrolyzed or partially hydrolyzed tare fruit extract (Caesalpinia |

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| extracts from tara ( Caesalpinia spinosa ) pods using conventional and MIR techniques. Grasas Y Aceites, doi: 10.3989/GYA.0228191 (Herman et al., 2020) | | | spinosa) (for 4 and 9 hours), one without antioxidants and one with 200 ppm BHT. Several conventional techniques (induction time, peroxide value, conjugated dienoic acid, p-anisidine number, total unsaturated fatty acids and α-linolenic acid content) and MIR spectroscopy coupled with chemometric tools were used and compared. The results showed that whatever antioxidants were added, the oil from sacha inchi was quite stable over time. The results also showed that tara fruit extract, especially partially hydrolyzed, was more efficient than BHT in fighting oil oxidation for up to 7 days. Finally, this paper shows that MIR spectroscopy presents an attractive alternative technique for monitoring oil oxidation from sacha inchi. |
| Blanca, Hernández-Ledesma., Luis-Felipe, Gutiérrez. Isolation and Characterization of Protein Fractions for Valorization of Sacha Inchi Oil Press-Cake. Foods, (2023). doi: 10.3390/foods12122401 (Torres-Sánchez et al., 2023) | Oil | Quasi-experimental study | In this study, three extraction procedures (varying pH values (7.0 and 11.0) and salt addition (0 and 5%)) were investigated to obtain seven different protein fractions (SIPF) from SIPC, characterized in terms of their protein content. , electrophoretic profile, secondary structure, and techno-functional properties. Sacha Inchi Oil is rich in protein (54.5-56.9%), dietary fiber (13.9-18.2%), and minerals (6.1-6.4%), making it a valuable ingredient for conscious consumers health.Consumption of Plukenetia volubilis Linnaeus reduces postprandial triglyceridemia in young adults. |
| Saroat, Rawdkuen., Stefano, D'Amico., Regine, Schoenlechner. (2022). Physicochemical, Functional, and In Vitro Digestibility of Protein Isolates from Thai and Peru Sacha Inchi (Plukenetia volubilis L.) Oil | Oil | SDS-PAGE | This study aims to determine the differences in protein isolates obtained from SI oil cakes from Thailand and Peru. The protein content and protein yield of Thai and Peruvian SI were estimated to be 93.27, 90.67%, and 49.15, 59.32%, respectively. The protein pattern of the Thai and Peruvian SI samples analyzed by SDS-PAGE showed glycoprotein as the main protein, with a |

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| Press-Cakes. Foods, doi: 10.3390/foods11131869 (Rawdkuen et al., 2022) | | | molecular weight of 35 kDa. The two protein isolates (PI) showed water and oil holding capacities ranging between 2.97–3.09 g/g sample and 2.75–2.88 g/g sample, respectively. The emulsifying property of PI from SI Thailand was higher than that of Peru ($p < 0.05$), while the foaming property was not comparable to the emulsion property. Thai SI samples showed lower digestibility up to 120 minutes in vitro digestion time compared to Peruvian SI samples ($p < 0.05$). However, in vitro pepsin digestion simulations of the Thai and Peruvian Si samples showed hydrolyzed protein bands compared to trypsin digestion, which showed no protein pattern in both SI samples on 4–20% gradient gels. These results indicate that protein isolates from SI Thailand and Peru show marked variations in physical and techno-functional properties and have high potential for use as plant-based protein additives for non-animal protein-rich foods in the future. |
| Huynh, Cang, Mai., Duy, Chinh, Nguyen., Nguyen, Phu, Thuong, Nhan., Long, Giang, Bach. (2020). Physico-Chemical Properties of Sacha Inchi (Plukenetia volubilis L.) Seed Oil from Vietnam. Asian Journal of Chemistry, doi: 10.14233/AJCHEM.2020.22233 (Mai et al., 2020) | Oil | GC-FID HPLC/UV-VIS | Through a gas chromatography-flame ionization (GC-FID) process, the fatty acid composition in the oil was analyzed, showing that the oil was rich in linoleic acid (42.62 %), linolenic acid (36.32 %) and oleic acid (11.64 %). %) . Tocopherol levels in the oil were also high (7.7 ± 0.005 mg/Kg), as demonstrated by high performance liquid chromatography/ultraviolet-visible detector (HPLC/UV-VIS). The physico-chemical properties of the oil were also checked, including viscosity (88-92 cP), acid number (2.05 ± 0.005 mg KOH/g), saponification content (183.5 ± 1.45 mg KOH/g)\nd iodine number (192.4 ± 1.55 grams I2/100 grams). The research results also show that sacha inchi is an oil that is beneficial for health because of its high |

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| | content of essential fatty acids (ω-3, ω-6 and ω-9). Sacha inchi seed oil is beneficial for health due to its high levels of essential fatty acids (omega-3, omega-6, and omega-9) and tocopherol, supporting overall well-being. |

Various food ingredients can be fortified by adding 10-40% sacha inch.Fortification of Sacha Inchi seed flour in snack products increases protein, fiber and antioxidant content, making it a promising and healthier snack option for consumers(Jiapong & Ruttarattanamongkol, 2021) The use of sacha inchi (SI) seeds as a food ingredient or traditional medicine, and the results show that SI seeds have the potential to be developed as a nutraceutical, namely healthy food, especially to treat cholesterol and hypertension. (Marina Silalahi, 2022))Protein concentrate from sacha inchi has also been used as a functional ingredient in various types of food. The addition of this protein concentrate can improve the texture of the sausage and increase its shelf life. In addition, sacha inchi protein has been used to make quality non-soy vegetable protein blends to increase satiety, maintain a healthy weight, and lean body mass.

Plukenetia volubilis is a promising plant that has great potential for further domestication and has an excellent oil composition, good sensory acceptability, is very suitable for cultivation, and has many potential applications in, for example, gastronomy, medicine, and cosmetics (Chasquibol et al., 2023)

## CONCLUSION

Based on the literature study that has been carried out, the sacha inchi plant (*A rolling blanket*L.) has various contents such as fatty acids, tocopherols, phytosterols, triglycerides, polysaccharides and others which are beneficial for health. The compounds contained in sacha inchi have antioxidant, anti-inflammatory, antibacterial, antidiabetic, immunomodulatory activity and are a source of nutrition. This shows that the sacha inchi plant can be used as a source of food, medicinal ingredients, cosmetics and other commercial products.

Limitations of research that shows testing*alive*and clinically to test the pharmacological activity of the sacha inchi plant can provide motivation to continue developing and exploring information to ensure the feasibility of using sacha inchi as an alternative source of food and raw materials that can be utilized optimally, especially in the health sector.

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