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Comparison of Proximate Analysis in Three Species of Ficus Fruits

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Abstract
The genus Ficus comprises various species that exhibit differences in their nutritional composition, including *Ficus aurata (Miq.)*, *Ficus padana Burm. f.*, and *Ficus racemosa L*. This study focuses on proximate composition such as moisture, ash, protein, fat, and carbohydrates present in the fruits of three species of genus Ficus. Results showed that mean water content between 86.05 % and 90.28%, total ash content changes between 0.78% and 0.94%, mean crude protein levels suitable almost up 0.45% to 1.24%, carbohydrate percentage varied from 7.59% to 11.40%. The analytical evaluation was successful in establishing the presence of heterogeneities in the qualitative proximate composition of the three studied species. *Ficus aurata (Miq.)* was found to have the maximum crude protein contents among the species investigated. *Ficus padana Burm. f* exhibited the highest fat content and efficiency in fat metabolism than the analysis carried out on the other species. Besides, carbohydrate content of *Ficus padana Burm. f.* greater quantity than those in the other two species. The current study highlights the characteristics of Ficus species for expansion in terms of concepts for food product development, nutrition and health.

INTRODUCTION

Ficus is a genus of plants that belongs to the Moraceae family. More than 800 species are described, many of which have high economic and ecological value. In addition, it is well-known that figs make a vital contribution to nutrition since foods rich in those beneficial components are provided (Rasool *et al*., 2023; Shukla, 2024). The leaves and the fruits go further uses as they serve as traditional medicine because of the highlighted importance (Badgujar, Patel, Bandivdekar, & Mahajan, 2014; Ogunlaja, Moodley, Baijnath, & Jonnalagadda, 2022).

This research examines *Ficus aurata (Miq.)*, *Ficus padana Burm. f* and *Ficus racemosa L.* This group of trees-since many in-depth studies have been covered how they can be utilized as food and help provide useful nutrition to some diets. These species belong to the Moraceae family, many species of these plants bear fleshy edible fruits which are eaten in many parts of the world.

Determining the proximate analysis of fruits above elucidates what nutrients are likely to affect people's dietary habits and health in general. The study of Ficus aurata has pointed out particular constituents of polyphenols, such as anthocyanins, that

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contribute to its antioxidant properties. Most of her fruits are widespread, and some examinations using liquid chromatography-mass spectrometry reported more than seven forms of anthocyanins in the Ficus aurata fruits, implying the plant has antimicrobial attributes and could help manage close inflammatory conditions and oxidative stress (Syukri, Ismed, Derosya, Nanda, & Gultom, 2019). Such potentials are fundamental not only in enhancing health status but also in decreasing chronic disease risk.

Ficus padana Burm. f. has curried favor not merely for being ecologically relevant, such as in the case of food for the Javan gibbon (Irawan, 2023). This shows the dual advantage of the *Ficus padana Burm. f.*, which supports the ecosystem and caters to the people.

Nonetheless, although such literature is less prolific in the case of the *Ficus padana Burm. f.* than the Ficus racemosa L., it is anticipated that the nutritional potential of *Ficus padana Burm. f.* will be very high, given what is known about the common trends in other species of Ficus where the fruits are rich in carbohydrates and other essential nutrients.

Comprehensive studies have also been performed on the structure and benefits of *Ficus racemosa L.* common fig. Biochemical methods have indeed been proven useful, and the fruits of Ficus racemosa have been shown to contain several nutrients, such as carbohydrates, proteins, advanced minerals, and which supplement the diets of individuals (Sadia *et al*., 2014). The positive aspects include numerous phytochemicals such as flavonoids or tannins in Ficus racemosa, which can be beneficial on some levels as having antioxidant and anti-inflammatory properties (Osowe, Olowu, Adu, Oloruntola, & Chineke, 2021). They also reported improved health parameters, including digestion and enhanced immunity, when using Ficus racemosa.

Ficus aurata (Miq.), *Ficus padana* Burm .f., and *Ficus racemosa L.* are some of the reasons for their nutrient composition, which has excellent health benefits. Foods from these Species are interesting because they all contain unique characteristics that further their use when they grow naturally and are consumed. This study aimed to assess the fruit trees *Ficus aurata (Miq.)*, Ficus padana Burm .f., and *Ficus racemosa* L.and give their thought on their use in food products.

MATERIALS AND METHODS

Materials and reagents were also crucial in carrying out the research, including the samples of *Ficus aurata (Miq.)*, *Ficus padana* Burm. f and *Ficus racemosa L.* fruits were sourced from Limau Manis, Pauh, West Sumatera areas. The research also required the materials for analysis, such as 0.255 N H2SO4 solution, NaOH (0.3 N, 0.1 N, 40%), anhydrous Na2SO4, CuSO4, aqueous, HCl (0.1 N), Phenolphthalein indicator, ethanol, solvent n-hexane, alcohol 95%, K2SO4 10%.

Instrumentation

The instruments in this research are an oven, desiccator, hotplate, Kjeldahl flask, analytical balance, distillation, 250 mL fat flask, extract paper, fat-free cotton, Soxhlet apparatus, Erlenmeyer, return more relaxed, buncher funnel, 25 mL crucible cup, metal cup, 500 mL beaker. Stir bar, litmus paper, filter apparatus, Furnace, crucibles, pestle and mortar, spatula and extraction tool.

Sample Preparation

The raw material for fresh fruit, cleaned, peeled, and removed other than the flesh. This type of raw material is then placed in a closed container. The fruit is cut into regular shapes and measuring pieces. Subsequently, the washed and drained sliced fruit is placed in the refrigerator for several hours and then in the dry container before analysis.

Proximate Analysis

Samples were analyzed in triplicate for moisture, ash, and fat content following the standard methods specified by (AOAC, 2005). The protein contents of the samples were determined using the microkjeldahl system employing the distillation and digestion units; for carbohydrate content determination, the weight difference method was employed utilizing moisture, ash, fat, and crude protein data. All the analyses were done in triplicate, and the final values are expresses as their means.

Statistical Analysis

Based on the data obtained, the water, carbohydrate, fat, protein and ash content of ficus fruit will be calculated for each parameter. Data is presented in table form with average values and standard deviation analyzed using Microsoft Excel.

RESULTS AND DISCUSSION

The water content of *Ficus racemosa L.* has been established at 90.28%, significantly greater than that of *Ficus padana Burm. f.* (87.22%) and *Ficus aurata (Miq.)* (86.05%). This noted high moisture content might depict that *Ficus racemosa L.* is generally fresher and, therefore, more marketable because of the high moisture content. It is a general observation that the water content in fruits shows the degree of deterioration they have suffered because it is related to turgidity, quality, and other parameters that determine consumer satisfaction and marketability of fruits (Kader, 2002). The proximate analysis of three species of ficus fruits showed in table 1.

Table 1. Proximate analysis of three species of ficus fruits

Species	Moisture (%)	Ash (%)	Fat (%)	Crude Protein (%)	Carbohydrate (%)
Ficus aurata (Miq.)	86.05±0.11	0.94±0.17	0.38±0.01	1.24±0.02	11.40±0.09
Ficus padana Burm.f.	87.22±1.12	0.80±0.02	0.82±0.15	0.45±0.01	10.71±1.08
Ficus racemosa L.	90.28±0.18	0.78±0.18	0.29±0.04	1.06±0.01	7.59±0.27

The high-moisture content in *Ficus racemosa L.* can be explained based on the nutrients provided in the growing accommodative conditions, including high humid conditions suitable for moisture retention. Fruits with a lot of water in them have superior texture and flavor properties since they appeal to the senses of sight, taste, and smell (Hussein, Fawole, and Opara 2020). This is particularly important in the case of consumer preference, as it is more likely that marketable fruits will keep their firmness and juiciness. Also, the high water content that reflects freshness can be related to fruit nutrients; for instance, fresh fleshy fruits are more nutritious than dry fruits, which are less than fresh fleshy fruits (Medyouni *et al*. 2021)

Figure 1. Three species of *ficus fruits*

The high moisture content levels can be beneficial to quality health, they also cause more problems with the longevity and nutritional quality of the end product. High-moisture fruits are more prone to microbial infections and enzyme activities, which may cause spoilage (Ojerinde *et al*. 2021). In the case of *Ficus racemosa L*., high moisture content can only be ignored with implementing appropriate postharvest handling and storage conditions. This aims to prolong food parameters shelf life by manipulating temperature and humidity without affecting their nutritional value.

Further, prolonged storage of highly perishable fruits such as *Ficus racemosa L.* often leads to the leaching of nutrients, especially water-soluble ones. Studies have shown that high humidity adversely affects nutrients, with loss of vitamins, especially ascorbic acid, a significant concern (He *et al*. 2022). Thus, although the high-moisture content of *Ficus racemosa L.* improves its quality at first, it also means that the improvement has to be made through reconciliation so that the nutritional values are not wasted during the postharvest of the product.

In connection with the above, when thinking of *Ficus racemosa L.* in terms of comparison with *Ficus padana Burm.f* and *Ficus aurata (Miq.)*, the differences in the content of moisture could be influenced not just by the inherited characteristics but also by other factors such as the habitats in which these species are found. *Ficus racemosa L.* is commonly found in tropical areas of significant humidity (Kader, 2002).

Ficus racemosa L. has a lot of moisture within its fresh fleshy fruit, which means that it is of quality, freshness, and aesthetic standard. Unfortunately, this leads to other challenges about shelf life quality and nutritional stability. Research in the future aims to manage postharvest handling measures so that the advantages of moisture content do not turn into spoilage and loss of nutrients.

Based on the information in Table 1, the Ficus species contain low ash content in the analyzed samples. The ash content 0.94%, 0.80% and 0.78% is observed in *Ficus aurata (Miq.), Ficus padana Burm.* f and *Ficus racemosa L.* respectively. Fruits low in ash content show that these fruits contain some minerals, but they are not the majority nutrients in these fruits, which means that other nutrients like carbohydrates, proteins, and fats are the primary nutrients in these fruits (Mokria *et al*. 2022; Yiblet 2024).

The ash content is a provision usually interpreted as collecting minerals in the food matrix per gram of source. In the case of lower values above from foods in question, these fruits are of low importance as food sources for mineral content. This could affect the functionality of these fruits in the diet, especially when minerals are deficient and these fruits are mostly incorporated into the diet.

The low ash content indicates that other nutrients are the main focus of these fruits. Thus, they are likely to be more of an energy-provisioning food than a mineral-containing one. For instance, certain Ficus species can be consumed because of their high content of carbohydrates that can provide instant energy (Yiblet, 2024).

These Ficus species also have lower ash content than some other edible fruits. For example, certain wild edible fruits have been reported to contain higher ash since they are said to be mineral-rich.

This comparison raises an issue of possible dietary inadequacies in the absence of other foods containing minerals lacking in the Ficus fruits (Mokria *et al*. 2022).

The low ash content is also essential as it raises the issue of how these fruits behave within their natural environments regarding ecology and nutrition. Fruits not rich in minerals may also have other different ecological functions in their ecosystems, especially that of attracting fruit-eating animals with other mineral sources in their diets. The low mineral content could affect these species' growing and agricultural practices as farmers might have to consider that they will have to augment the mineral deficiency with minerals from other crops or foods.

The assessment of fat content reveals that *Ficus padana Burm. f.* contains the highest fat content of all the three species evaluated at 0.82% value, followed by decreasing value of fat inclusion by *Ficus aurata (Miq.)* at 0.38% and *Ficus racemosa L.* at 0.29%. It has been noted that *Ficus padana Burm. f.* holds higher fat content as compared to other species of Ficus because of a tendency to possess a greater fat potential. This is especially important in this regard since fats are a densified energy containing component of nutrition. This explains the orientation of the triglycerides contained in the Ficus plants, for example, in *Ficus carica* which play an active role of energy storage hence the significance of *Ficus padana Burm. f* in terms of fats energy intake purpose (Kara, 2021).

The fat content of *Ficus padana Burm. f* implies that it could be used as an energy source, but somewhat limited in comparison with other food types. Fats are one of the essential macronutrients and the most concentrated energy source, providing the available vitamins A, D, E, and K through lipids (Burdurlu, Koca, and Karadeniz 2006). Even if the fat content of these Ficus spp. is low, the contribution of fats will not be insignificant, which is helpful, especially in diet practices where energy is dense.

Among the various fruits, *Ficus padana Burm. f* contains the least fat content. Avocados and olives contain high amounts of healthy levels of fat, especially monounsaturated fats, which have several health benefits (Li *et al*. 2013) and should be included in healthy diets. On the other hand, the low amounts of fats in Ficus species lead one to conclude that such foodstuff cannot form the chief constituents of diet as fats but rather supplement other foods.

However, in the case of *Ficus padana Burm. f*, one crucial aspect that must be considered is the distribution of fats. Healthy fats in the diet have been shown to have several health benefits, including improvement in heart health and reduction of inflammatory diseases (M. Khan *et al*. 2011). Thus, characterizing fatty acids in *Ficus padana Burm. f* and determining their health effects would be an appropriate research suggestion for future studies.

The fat content in *Ficus padana Burm. f* also has ecological implications, especially as it is an animal food resource. Several frugivorous animals use fruit as their source of energy; for this reason, the higher fat the *Ficus padana* has, the more food the species can support, which enhances biodiversity in their habitats (Yiblet, 2024). Furthermore, the consumption of Ficus fruits in the region may also depend on the fat content, making the fruit culturally important.

Ficus padana Burm. f contains the highest fat content per unit of dry matter among the three species studied, its overall fat levels remain relatively low. This trait, however, underlines the reserve potential of *Ficus padana Burm. f* as an energy source, especially when considering its carbohydrate content simultaneously. Further studies need to focus on what specific fats are in these species, the health benefits, and the ecological significance of these fruits in their natural environment.

Based on crude protein content analysis, *Ficus aurata (Miq.)* contains 1.24%, followed by *Ficus racemosa L.* and *Ficus padana Burm. f* at 1.06% and 0.45%, respectively. That higher protein and probably potential health benefits is likely because the protein content of *Ficus aurata (Miq.)* fruits compared with other species studied is better, which raises the protein-related benefits of the fruit (Rusmadi *et al*. 2020).

Ficus aurata (Miq.) is expected as it is an essential nutritional and dietary protein. *Ficus aurata (Miq.)* is one of the protein-rich varieties of Ficus from the species of fig trees known for their green, odorous leaves. Like other macromolecules, proteins are of particular importance since they are involved in various physiological processes, such as tissue reconstruction, defense, immunity, and enzyme subsistence. The presence of protein in food items like *Ficus aurata (Miq.)* will not only stand-alone but will complement other items within the diet.

The level of protein in *Ficus aurata (Miq.)* cannot be compared with the levels found in other protein-rich sources, such as meat, but it is encouraging when contrasted with many different varieties of fruits with generally low protein levels. For example, bananas or apple fruits contain protein content that is less than 1% (Supriya *et al*. 2023). This puts *Ficus aurata (Miq.)* consumption in this respect as one of the few fruits with protein richness, creating an option for

those who want adequate protein in their diets, more so from plant sources.

As for the case of *Ficus aurata (Miq.)*, such elevated protein levels may offer additional health advantages in muscle preservation & building, control of weight, and feeling full. It is well known that diets that are high in protein more often lead to increased metabolic rate and reduced feelings of hunger, thus helping in controlling weight. Nonetheless, specific works that have linked these two aspects, *Ficus aurata (Miq.)* protein content and the associated health benefits, have been few and, therefore, require further exploration.

The protein content in these Ficus species also has ecological and cultural relevance. In many tropical areas, the fruits of Ficus are taken by man and animals, acting as a source of food that helps preserve biodiversity. This nutrient level can be crucial for fruits-eating animals, which depend on such fruits for their dietary requirements (Yiblet 2024). In addition to this, because of the high protein content of the Ficus fruits, their cultural relevance as a traditional food may be elevated, thus making them useful in many types of cuisines.

The higher protein score was noted in *Ficus aurata (Miq.)* in comparison to *Ficus racemosa L.* and *Ficus padana Burm. f* substantiating its usefulness as a good source of protein food. Deficient absolute protein levels may persist, but on a positive side, aid in fortifying the nutrition profile of fruits. Further studies of these directions are needed to understand the amino acids of the proteins present in these species and the health benefits they may have. Understanding these fruits' ecological role in their nature is also essential.

The highest carbohydrate content is found in *Ficus aurata (Miq.)* with (11.40%), while *Ficus padana Burm. f* takes the second place (10.71%), and the third place is taken by *Ficus racemosa L.* (7.59%). The high percentage of carbohydrates found in *Ficus aurata (Miq.)* indicates that this fruit could be a better source of energy than the other species and beneficial in situations where energy intake is the targeted goal (Rusmadi *et al*. 2020).

Carbohydrates constitute the significant portion of a diet for most people, so it is understandable that *Ficus aurata (Miq.)*, being fibrous and containing high carbohydrates, attracts consumers searching for energy foods. The energy from carbohydrates is one of the main substantial contributors of energy needed in a range of bodily activities, such as physical activities and even metabolism. Carbohydrate content in *Ficus aurata (Miq.)* can thus help meet daily energetic requirements quite significantly, especially in places where there may be a lack of other energy sources (González *et al*. 2015).The carbohydrate content of these Ficus species is impressive when we assess it against the carbohydrate content of many other fruits which are relatively lower in carbohydrate content. For instance, average fruits like apples and oranges have 8% to 10% of carbohydrates (Kouřimská *et al*. 2014). In this regard, *Ficus aurata (Miq.)* is ideal for individuals who are on a fruit diet and need some carbohydrates, as this Ficus species is commercially viable.

The carbohydrates in *Ficus aurata (Miq.)* are assumed to be simple sugars that the body efficiently utilizes for energy. A more detailed examination of the carbohydrates in the food, including glucose and fructose, will also help pinpoint their potential health benefits or damage in persons with specific health problems, especially diabetes. Diet variation is another crucial criterion, and in this regard, fruits like *Ficus aurata (Miq.)* may be more beneficial than refined sugar (N. Khan and Sultana 2005).

The carbohydrate content in Ficus fruits also has implications on the ecology of the fig fruits, especially when considering their utilization as food for wildlife. Numerous species of animals can be termed as frugivorous, which need to consume fruits for sustenance, and the availability of *Ficus aurata (Miq.)* with its high levels of carbohydrates may bolster these species, thus enhancing diversity in their ecosystems (Serio-Silva *et al*. 2002). The contribution of carbohydrates in local Ficus fruits might also increase their importance in the carbohydrate-based nature of the Ficus fruit.

Ficus aurata (Miq.) has been established to have more carbohydrates than *Ficus racemosa L.* and *Ficus padana Burm. f.* This implies its import as an energy-giving food in the diet. Even though the levels of carbohydrates available are targeted for good effect, there is still the need to examine what carbohydrates are available to explain the health aspects and how the particular fruits impact the environment where they are naturally grown.

CONCLUSION

The results for the nutritional characteristics of the species were significantly different. Regarding protein (1.24%) and carbohydrate (11.40%), The most significant amount of fat content was noted in *Ficus padana* (0.82%), while water was for *Ficus racemosa* (90.28%). The percentage of ash content was relatively low in all the species, with *Ficus aurata* showing the highest rate of 0.94% and *Ficus racemosa* the least with 0.78%. These results also bring to the attention the different nutritional compositions of Ficus species, which may be helpful

in food and health promotion about the bioactivity of Ficus species. This study helps to make meaningful choices in terms of the use of specific Ficus species for food and for dietary purposes depending on the characteristics of each species.

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