



# Brown Rice Consumption Effect on Blood Sugar Levels in Type-2 Diabetes: Bibliometric Analysis

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**Abstract** – The bibliometric analysis aimed to explore brown rice consumption's impact on blood sugar levels, particularly for type 2 diabetes patients. It utilized Publish or Perish software and Google Scholar database alongside Microsoft Excel 2016 and VOSviewer for data visualization. Using keywords like "brown rice," "blood sugar levels," and "type-2 diabetes," the analysis identified influential researchers like Zhang, Y, and Liu, L. Findings revealed Elsevier as the leading publisher, with a notable citation count of 703. The prevalent terms in the research encompassed "rice," "brown rice," and "health benefits," forming 10 distinct clusters. This research theme, crucial for health, is projected to progress further, emphasizing the significance of carbohydrates in health and well-being. The analysis showcased trends, influential contributors, and prevalent topics, underscoring brown rice's importance in managing blood sugar levels, especially for individuals with type 2 diabetes.

**Keywords** – Brown rice, blood sugar levels, and type 2 diabetes.

## I. INTRODUCTION

Rice is the seed of the grass species *Oryza sativa* (Asian rice). This cultivated rice is a cereal grain and has a role as the staple food that is most consumed by more than half of the world's human population [1] especially countries in Asia and Africa. In terms of production, rice is ranked third as the agricultural commodity with the third highest production in the world, after sugar cane and corn [1]. Corn and sugar cane commodities are also known as animal feed, while rice is generally used as a food source of carbohydrates by humans. Rice from this paddy provides more than a fifth of the calories consumed by humans throughout the world, making this rice the most important food crop in terms of nutrition and human calorie intake [2]. There are many types of rice, and culinary preferences tend to vary by region, these preferences are also related to the sensory habits of a group of people.

There are many names for types of consumption rice circulating on the market. One of them is brown rice. This rice is whole rice whose outer shell is not usually consumed because the texture is less familiar to the tongue. This type of rice has the outer husk removed but the bran and germ layers remain, resulting in a brown or brownish rice color [3]. If this brown rice is polished, it will become white rice which is the same grain but

without the skin, bran layer, and also the germ layer. In fact, brown rice, golden rice, and black rice (often also called purple rice) are all whole rice with different pigmented outer layers, which can be influenced by the intensity of the texture of the rice grains, which also influences the total nutritional differences between the types of rice. Alone.

Brown rice is whole rice with only the husk (outer layer) removed. To produce white rice, the next layer below the husk (bran and germ layer) is removed leaving most of the starchy endosperm. Some food vitamins and minerals are lost in this removal and subsequent polishing process. Among them are the oils in the bran, which are removed along with the bran layer, dietary fiber, small amounts of fatty acids, and magnesium. Some of these missing nutrients, such as vitamins B1 and B3, and iron, are sometimes added back to white rice. In the US, the result is called "enriched rice" and must comply with Food and Drug Administration (FDA) regulations for this name to be used [4].

It was also found that germinated brown rice had a more complete amino acid profile, including [5]. The specific nutritional composition of brown rice per 100 grams can be seen in the following table (see **Table 1**).

**Table 1.** Nutrition facts for brown rice per 100 grams [6]

Name	Amount	Unit	Deriv. By
Water	70.3	g	Analytical
Energy	123	kcal	Calculated
Energy	514	kJ	Calculated
Protein	2.74	g	Analytical
Total lipid (fat)	0.97	g	Analytical
Ash	0.44	g	Analytical
Carbohydrate, by difference	25.6	g	Calculated
Fiber, total dietary	1.6	g	Analytical
Sugars, total including NLEA	0.24	g	Analytical
Sucrose	0.24	g	Analytical
Glucose	0	g	Analytical
Fructose	0	g	Analytical
Lactose	0	g	Analytical
Maltose	0	g	Analytical
Galactose	0	g	Analytical
Starch	24.8	g	Analytical
Calcium, Ca	3	mg	Analytical

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Name	Amount	Unit	Deriv. By
Iron, Fe	0.56	mg	Analytical
Magnesium, Mg	39	mg	Analytical
Phosphorus, P	103	mg	Analytical
Potassium, K	86	mg	Analytical
Sodium, Na	4	mg	Analytical
Zinc, Zn	0.71	mg	Analytical
Copper, Cu	0.106	mg	Analytical
Manganese, Mn	0.974	mg	Analytical
Selenium, Se	5.8	µg	Analytical
Thiamin	0.178	mg	Analytical
Riboflavin	0.069	mg	Analytical
Niacin	2.56	mg	Analytical
Pantothenic acid	0.38	mg	Analytical
Vitamin B-6	0.123	mg	Analytical
Folate, total	9	µg	Analytical
Folate, food	9	µg	Analytical
Folate, DFE	9	µg	Calculated
Choline, total	9.2	mg	Analytical
Betaine	0.5	mg	Analytical
Vitamin E (alpha-tocopherol)	0.17	mg	Analytical
Vitamin K (phylloquinone)	0.2	µg	Analytical
Fatty acids, total saturated	0.26	g	Calculated
Cholesterol	0	mg	Assumed zero (Insignificant amount or not naturally occurring in a food, such as fiber in meat)

The number of calories and carbohydrates contained in brown rice and white rice is the same, namely between 72% and 82% of the dry weight of brown rice, most of which is in the form of digestible starch. [7], [8]. Brown rice is also known to have the lowest protein and fiber content compared to cereal grains [8].

This type of rice is a good source of vitamin B6, magnesium, phosphorus, selenium, thiamine, niacin and manganese, and contains a small amount of fiber. White rice has different nutritional content from brown rice, because the bran and germ layers have been removed [9].

Polishing the outside of the rice apparently affects the glycemic index (GI). It is known that the average glycemic index for brown rice is 55, which is considered low. A low GI is considered healthier than a

high GI. The average glycemic index for white rice is higher, namely 64 on a scale of 100 [10].

Low GI ( $\leq 55$ ), examples include fruit products, milk, pasta, coarse bread, porridge (oats), soybeans, nuts, brown rice and lentils. Medium GI ( $>55$  to  $69$ ), examples include orange juice, honey, basmati rice, white rice, and whole wheat bread. High GI (greater than  $70$ ), examples include potatoes, white bread, and short grain rice [11].

The glycemic index (GI) is a reference for how quickly a food can increase blood sugar (glucose) in our body. Only foods containing carbohydrates have a GI. While foods such as oil, fat and meat do not have a GI, in diabetes sufferers, these foods can affect blood sugar [12]. In general, low GI foods increase glucose slowly in the body, in contrast to foods with a high GI which will cause a very high spike in blood sugar in the body after eating. If illustrated, the GI graph will be sharp if we consume foods with a high GI, vice versa The GI graph will rise slowly and normally if we consume low GI so that the GI graph can slowly fall back to normal again. Foods with a high GI increase blood glucose quickly. If you have diabetes, high GI foods can make it difficult to control diabetes [13].

The glycemic index ranks carbohydrates on a scale of 0 to 100 based on how quickly and how much they increase blood sugar levels after eating. Foods with a high glycemic index are known to cause large blood sugar fluctuations. Foods with high levels of available carbohydrates have a high glycemic index (GI), more details are as follows:

- Low glycemic foods have a rating of 55 or less, and foods with a rating of 70-100 are considered high glycemic foods. Mid-range foods have a glycemic index of 56-69.
- Eating a lot of foods with a high glycemic index, which cause strong blood sugar spikes, can lead to an increased risk of type 2 diabetes, [14] heart disease, [15], [16], and overweight [17], [18], [19].
- Early research linking high glycemic index diets to age-related macular degeneration, [20] ovulatory infertility [21], and colorectal cancer [22].

Foods with high levels of unavailable carbohydrates have a low GI. Available carbohydrates can become unavailable due to chemical modification, processing, or interactions with other components [23]. Carbohydrates that break down quickly during digestion have a higher glycemic index. These high GI carbohydrates can release glucose into the blood quickly. In contrast, low GI carbohydrates break down slowly releasing glucose gradually into the bloodstream. In healthy people, insulin then starts to work, and blood sugar levels return to pre-meal levels 2 hours after eating [11]. In untreated diabetes patients, blood sugar levels do not return to pre-meal levels on their own. Even blood sugar levels remain high two hours after eating. As a result, the risk of developing diabetes increases because insulin is not secreted properly, or does not function properly in the body. Brown rice, with its low GI and high fiber content,



is said to be able to significantly reduce blood sugar levels after eating in overweight people, as well as type 2 diabetes sufferers [24]–[26]. There is a lot of research on the effect of consuming brown rice or carbohydrates with a low GI in reducing post-meal blood sugar levels, especially in helping control type 2 diabetes. Therefore, bibliometric analysis on this theme is very interesting and important to study.

Bibliometric methods are often used in the field of library and information science. Bibliometrics is so closely related to scientometrics, the analysis of metrics and scientific indicators, that the two fields largely overlap. Citation analysis is a commonly used bibliometric method that is based on creating citation graphs [27] a network or graphical representation of quotes shared by documents. Bibliometrics is the use of statistical methods to analyze books, articles and other publications, especially those containing scientific content. Many research fields use bibliometric methods to explore the impact of their field, the impact of a group of researchers, the impact of a particular paper, or to identify papers that have had a particular impact in a particular research field.

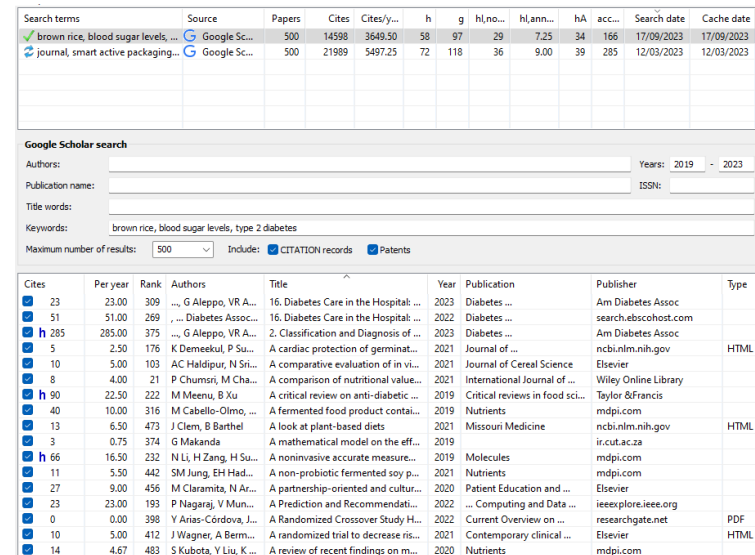
VOSviewer can also help in preparing a bibliometric analysis, VOSviewer is a software tool for building and visualizing bibliometric networks. These networks can for example include journals, researchers, or individual publications, and they can be built on citations, bibliographic coupling, co-citations, or co-authorship relationships. VOSviewer also offers text mining functionality that can be used to build and visualize co-occurrence networks of key terms drawn from the body of scientific literature. bibliometric analysis and exploring relationships between ecopreneurship documents using relational techniques. The results highlight publication trends; the most cited documents, the authors with the greatest contributions, the countries and institutions with the highest productivity, and the journals that have contributed the most to the research field [28].

Apart from VOSviewer, there is also the Publish or Perish application which provides tips and tricks for conducting bibliometric research on authors and journals and provides a detailed evaluation of the two main data sources for citation analysis: Google Scholar and Thomson ISI's Web of Science, or as you can see the most Widely used and popular is Google Scholar because it is very easy to access and is available for free. Bibliometric research refers to the quantitative analysis of a body of literature and its references: citations. This collection of literature can be grouped in various ways, such as grouping by author or journal [29].

## II. METHOD

In this database search, the articles searched are articles published on Google Scholar via the Publish or Perish (PoP) application. It is known that Google Scholar is a database that is very easy to access, has many

relevant articles on various themes, is available for free, and can be accessed easily at any time. In the PoP application, searching for articles in Google Scholar uses the keywords "brown rice", "blood sugar", "glycaemic index", and "diabetes" with a publication range over the last 5 years, namely 2019-2023 (see **Figure 1**). The search results in Publish and Perish are then saved in CSV file format, which will then be reprocessed and analyzed using Microsoft Excel 2016.



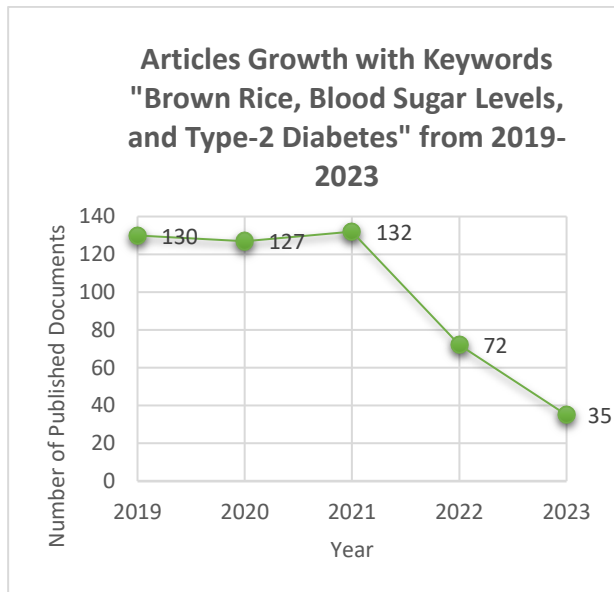
**Figure 1.** Search results on Publish and Perish in Google Scholar

The function of further analysis using Microsoft Excel 2016 is to systematically describe the results obtained through PoP so that the number of publications per year, authors, productivity and publishers can be analyzed using Microsoft Excel 2016. The VOSviewer application is also used so that it can be analyzed visually, because in VOSviewer trends can be observed specifically with data mapping filtering stages that can be selected and adjusted to research needs. Data mapping in VOSviewer that can be applied is network visualization, overlay visualization, and density visualization. The visualization results can also be used to observe data about research developments per year, relationships between authors and other authors, articles with citations and the most popular publishers, as well as studying clusters of articles resulting from the visualization.



### III. RESULT AND DISCUSSION

#### 1.1 Publication Trends (Research Developments)



**Figure 2.** Graph of article development with the keywords "brown rice, blood sugar levels, and type-2 diabetes from 2019-2023.

Developments regarding research on the effect of brown rice consumption on blood sugar levels in type-2 diabetes are expected to continue to develop. However, after carrying out bibliometric analysis via Publish or Perish, it can be seen in the graph. that the development of articles with this theme has experienced a significant increase and decrease in the last 5 years, namely from 2019-2023. With the keywords "brown rice, blood sugar levels, and type-2 diabetes" results were found in published articles related to the keywords, namely in 2019 there were 130 published documents, in 2020 there were 127 published documents, in 2021 there were 132 published documents, in 2022 there were 72 documents were published, and in 2023 there will be 35 documents published. It can be seen that in 2019 the number of related article publications was high, then in 2020 the number decreased, while in 2021 it increased and was higher than 2019, but starting from 2022 the number of publications decreased until 2023, the decrease was very significant, reaching a publication rate of only 35 documents per this 2023. This means that further research needs to be carried out on this theme, which is also expected to help develop knowledge regarding appropriate carbohydrate intake and also its relation to the glycemic index of type 2 diabetes sufferers.

#### 1.2 Highest Rank Articles by Citation and Publisher

From a total of 496 articles, they were filtered and the top 10 articles were found based on citations and publisher sources. It is known in **Table 2** that in first place there were 703 citations with the title Type 2 diabetes mellitus, oxidative stress and inflammation: examining the links, 369 citations with the article title Role of diet in type 2 diabetes incidence: umbrella review of meta-analyses of prospective observational studies, 285 citations with the article title "Classification and Diagnosis of Diabetes: Standards of Care in Diabetes—2023", 258 citations with the title "Diabetes Self-Management Amid COVID-19 Pandemic", 257 citations with the article title "An Updated Review On Pharmaceutical Properties Of Gamma-Aminobutyric Acid", there are two article titles that have the same number of citations, namely 233 citations, both entitled "Diet And Exercise In The Prevention And Treatment Of Type 2 Diabetes Mellitus and Dietary Polyphenols and Type 2 Diabetes: Human Study and Clinical Trial", 223 citations with the article title "Rice: Importance for Global Nutrition", 217 with the article title "Nutritional and Functional Properties of Colored Rice Varieties of South India: A Review", and 197 citations with the article title "Brown Rice Versus White Rice: Nutritional Quality, Potential Health Benefits, Development of Food Products, and Preservation Technologies".



**Table 2.** Top 10 highest rank articles by citation

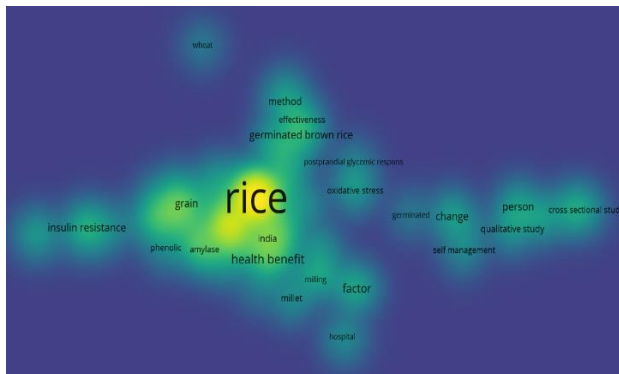
Cites	Authors	Title	Year	Publisher	GSRank
703	OO Oguntibeju	Type 2 Diabetes Mellitus, Oxidative Stress and Inflammation: Examining The Links	2019	ncbi.nlm.nih.gov	350
369	MNeuenschwander, A Ballon, KS Weber, T Norat...	Role Of Diet In Type 2 Diabetes Incidence: Umbrella Review of Meta-Analyses Of Prospective Observational Studies	2019	bmj.com	205
285	..., G Aleppo, VR Aroda, RR Bannuru, FM Brown...	2. Classification And Diagnosis of Diabetes: Standards of Care In Diabetes—2023	2023	Am Diabetes Assoc	375
258	M Banerjee, S Chakraborty, R Pal	Diabetes Self-Management Amid COVID-19 Pandemic	2020	Elsevier	162
257	DH Ngo, TS Vo	An Updated Review On Pharmaceutical Properties Of Gamma-Aminobutyric Acid	2019	mdpi.com	140
233	F Magkos, MF Hjorth, A Astrup	Diet And Exercise In The Prevention And Treatment Of Type 2 Diabetes Mellitus	2020	nature.com	345
233	H Cao, J Ou, L Chen, Y Zhang...	Dietary Polyphenols And Type 2 Diabetes: Human Study And Clinical Trial	2019	Taylor & Francis	227
223	NK Fukagawa, LH Ziska	Rice: Importance For Global Nutrition	2019	jstage.jst.go.jp	47
217	TS Rathna Priya...	Nutritional And Functional Properties of Coloured Rice Varieties of South India: A Review	2019	journalofethnicfoods.biomedcentral	91
197	ASM Saleh, P Wang, N Wang, L Yang...	Brown Rice Versus White Rice: Nutritional Quality, Potential Health Benefits, Development of Food Products, and Preservation Technologies	2019	Wiley Online Library	8



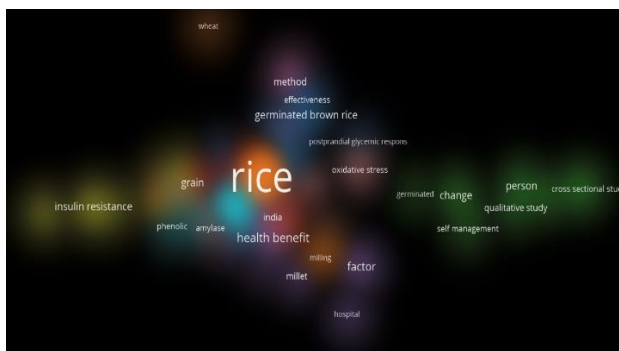




## 1.7 Density Visualization



(a)



(b)

**Figure 7.** Result of density visualization: (a) item density and (b) cluster density

This density visualization is presented with a description in two forms, namely in the form of item density (**Figure 7a**) and cluster density (**Figure 7b**). In the cluster density visualization, the color of a point in the visualization is obtained by mixing the colors of different clusters. The weight given to the color of a certain cluster is determined by the number of items belonging to that cluster in the neighborhood of the point [29].

## IV. CONCLUSION

It can be concluded from the bibliometric analysis of related research entitled "Brown Rice Consumption Effect on Blood Sugar Levels in Type-2 Diabetes" that the results show that during the last 5 years, namely 2019-2023, this research is still rarely carried out by researchers, especially since decrease in the number of publications from year to year. This topic had the highest popularity in 2021 with a total of 132 published articles, but this is decreasing as of 2023, namely only 35 published documents. This analysis also shows that the most citations regarding related articles reached 703 citations and it is also known that Elsevier is the most popular and popular publisher, while the most reputable authors on this topic are Zhang and Liu. In the visualization analysis, it was also found that out of 496

articles, 10 clusters were found, which dominated. With this bibliometric analysis, it is hoped that research on this topic can develop further as we remember the importance of self-awareness in consuming carbohydrates, especially for people with type-2 diabetes.

## THANK-YOU LETTER

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