

# Review on Antifungal Possibility of Locally Processed Brown Sugar With Comparative Physicochemical Selections of Honey As Standard Against Candida Albicans.

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**Abstract:** In recent years, fungal infections have become a serious health problem. *Candida albicans* as a case study are considered as the fourth most common isolates associated with approximately 40% mortality in bloodstream infections among hospitalized patients. Due to various limitations of classical antifungals used currently, such as limited kinds of drugs, inevitable toxicities, and high prices, there is an urgent need to explore new antifungal agents based on novel targets. Selected physicochemical characteristics of honey that has been extensively explored for the treatment of fungal infections over time were reviewed and compared with brown sugar. Parameters such as colour, pH, moisture, ash, viscosity, electrical conductivities, reducing sugar, free acidity, sucrose, total dissolved solids, and hydroxyl methyl furfural were compared. Conclusively, with the similarities of the selected physicochemical parameters (honey and brown sugar), brown sugar specifically might retain the potential of inhibiting the activity of *Candida albicans*. This will then presented another cheap, readily available and edible source of antifungal biomaterials. Further antifungal studies were recommended.

**Keywords:** Honey, brown sugar, *Candida albicans*, physico-chemical parameters and fungal infections.

## 1.0 INTRODUCTION

Fungal infections arise when an invading fungus destructively takes over the body's immune systems through air, soil and water. They retain a longer life span as they survive virtual everywhere [1]. However, some fractions of these microbes are beneficial, while others are equally dangerous and pathogenic [1]. There are thousands species of fungi as approximately 300 of them are recognized to make humans ill [2]. They are microscopic living organism that live at the exterior parts of the soil, on flowers, many indoor surfaces, on human pores and skin.

Mild fungal skin infections can appear like a rash that is typical of skin problems [2]. For instance, ringworm is a pores and skin contamination because of a fungus, and not a worm as the name implies. Similarly, fungal infections with lungs may be extra critical and often induce symptoms that are just like other illnesses such as flu or tuberculosis [2]. Fungal meningitis and bloodstream infections are less common than pores, skin and lung infections that are life threatening [2]. *Candida albicans* is a unicellular species of yeast that actually induce fungal infections in humans [3]. The species name, *albicans*, comes from Latin phrase for white because, the yeast appears white while cultured on a

plate [3]. However, agents like antibiotics, which kill both pathogenic and useful bacteria and other conditions that impair the body's immune mechanism, also throw off microbial stability of *C. Albicans* [4]. In the meantime about 90 percentage of the infections are due to other species of *Candida albicans* like, *C. glabrata*, *C. tropicalis*, *C. krusei* and *C. parapsilosis* [4]. Few researches estimated that approximately 20 to 80 percent of asymptomatic and healthy girls have *Candida* growth in their vaginas as common symptoms encompass vaginal itching and a burning sensation [4]. *C. albicans* is a popular fungus discovered within the oral part of all ages of thirty to forty five percentage of healthful adults, according to postgraduate clinical journal [4]. In spite of this occurrence, an oral infection with *C. Albicans*, that is known as thrush or oral candidiasis, is not always very common as it is can be managed and prevented [4]. Oral thrush in particular affects the younger, old, and those with weakened immune structures. Symptoms and signs of fungal infections are white creamy sores within the oral cavity, the tongue, inner cheeks, gums, and pain experienced from swallowing [4]. If a slight thrush contamination develops after antibiotic use, ingesting probiotics or yogurt with energetic cultures, or ingestion of *Lactobacillus acidophilus* (a useful microorganism) capsules could restore the stability of the

beneficial microbes as more critical infections require antifungal medicines, such as unique mouthwashes and lozenges [4]. Nutritionally, sugar refers to simple carbohydrates consisting of one or two fundamental simple sugar compositions with inclusive of glucose, galactose and fructose [5]. Most often, the use of sugar to describe simplest carbohydrates with sweet taste, is technically incorrect with regard to fructose, glucose and sucrose [6]. These simple sugars are barely distinct in chemical structure as sugar is a component of one glucose and one fructose [5]. The elements that distinguish sugars are their sources (sugarcane, beet, fruit, nectar, palm or coconut saps), flavor profiles, and manners of processing. Specifically, brown sugar is virtually white sugar with extra level of molasses [7]. A completely famous kind of sugar that is considered healthier due to its health advantages and distinctive than to ordinary crystallized white sugar [8]. Honey has a unique chemical structure that our bodies positively react with, which then makes brown sugar very appealing to those who need to rebalance their nutritional deficits with many of its advantages.

Brown sugar does not involve refining procedure unlike white or common sucrose. It is a direct product of boiled sugar cane juice after periods of crystallization [8]. The important natures of brown sugar include its brownish colour, strong taste that is honestly the availability of molasses [8]. Processed and white sugar can also be converted into brown sugar with the definite reaction of molasses in balanced quantities [8]. Essentially, brown sugar consists of between 3% to 7% molasses as is certainly wet [8]. The sugar particles are in maximum instances much less granulated than white sugar debris. Nutritionally, brown sugar has a lower calorie cost specifically due to the presence of water [8]. There are special varieties of brown sugar with common compositions of molasses with great supply of nutrients, vitamins, and minerals. Consumption of 145 gram of brown sugar offers 142.23 g of Carbohydrate, 1.03 mg of Iron, 120 mg of Calcium, 0.068 mg of Copper,

0.059 mg of vitamin B6, 193 mg of Potassium, 0.093 mg of Manganese, 0.191 mg of diet B5, 13 mg of Magnesium, 1.7 µg of Selenium, 41 mg of Sodium, 0.16 mg of vitamin B3 and 6 mg of Phosphorus [8].

Honey's compositions particularly depends on climatic and environmental situations during harvesting [10]. Honey carries at least 2 hundred materials mainly carbohydrates and water. It also incorporates minerals, proteins, free amino acids, enzymes, nutrients, natural acids, flavonoids, phenolic acids, and other phytochemicals [11]. It is precious for treatment of cardiovascular illnesses, cancer, cataract, and several inflammatory sicknesses as well as wound recovery. The healing actions of honey are because of its antioxidant and antimicrobial natures [12]. It is characterized typically for its microbiological, sensory, physical and chemical characteristics [11]. Many researches have been suggested on microbiological and physico-chemical characteristics of honey worldwide [11]. Thereby, sensitive and selected physicochemical characteristics of natural honey were reviewed, in ascertaining the antifungal suspicion of locally concentrated brown sugar.

#### **Water test for the purity of the honey sample**

Take a teaspoon of the honey and placed it in a glass complete of water. Fake or adulterated honey will dissolve within the water whilst natural honey which has a more dense texture will settle proper at the lowest of the glass as lumps. The equal is the case with blotting paper or white fabric. In case you pour pure honey on the 2, it's going to no longer get absorbed or leave stains. [13]

#### **Physico-chemical Analysis of locally made brown sugar.**

pH, moisture content, electrical conductivity, ash content, free acidity, reducing and total sugar can be conducted according to AOAC method [14].

**Table 1. Selected publications on antifungal activity of natural honey against fungi species (Candida albican)**

Title	Year	Fungus under study	Remark/Conclusion	Reference
Antifungal activity of honey from stingless bee <i>Melipona beecheii</i> against <i>Candida albicans</i>	2019	<i>Candida albican</i>	20% and above of <i>Melipona beecheii</i> through agar dilution assays and broth macro dilution method were concluded with higher inhibitory effects against <i>Candida albican</i>	[15]
Honey has an antifungal effect against <i>Candida spec</i>	2006	<i>Candida species</i>	Honey retains significant antifungal properties against clinical forms of <i>Candida species</i>	[16]
Antifungal Activity of Turkish Honey against <i>Candida spp.</i> and <i>Trichosporon spp.</i> : an in vitro	2009	<i>Candida spp.</i> and <i>Trichosporon spp</i>	Honey has an antifungal activity against fluconazole resistant strains in vitro at 80% (v/v).	[17]
Antifungal activity of four honeys of different types from Algeria against pathogenic yeast: <i>Candida albicans</i> and <i>Rhodotorula sp.</i>	2012	<i>Candida albicans</i> and <i>Rhodotorula sp.</i>	There was a direct antifungal activity against <i>Candida albicans</i> and <i>Rhodotorula sp.</i>	[18]
Honey has an antifungal effect against <i>Candida species</i>	2006	<i>Candida species</i>	Specified types of honey retain some antifungal activities against the clinically isolated <i>Candida species</i> .	[19]
Honey Flavonoids, Natural Antifungal Agents Against <i>Candida Albicans</i>	2011	<i>Candida Albicans</i>	Extracted flavonoid from natural multifloral honey inhibit the growth of <i>Candida albican</i> in vitro.	[20]
Investigation of in vitro antifungal activity of honey	2012	<i>Aspergillus niger</i> , <i>Aspergillus flavus</i> , <i>Penicillium chrysogenum</i> , <i>Microsporium gypseum</i> , <i>Candida albicans</i> , and <i>Saccharomyces sp</i>	Honey shows level of inhibition with <i>Candida albicans</i> at the point of concentration.	[21]
Agastache honey has superior antifungal activity in comparison with important commercial honeys	2019	Dermatophytes and <i>Candida albican</i>	The honey sample was active in the inhibition of both fungi species.	[22]

Portuguese honeys as antimicrobial agents against <i>Candida</i> species	2020	<i>Candida</i> species	This was a claim that portuguese heather honey offered the most similar physicochemical conditions with manuka honey with regards to its phenolic and flavonoids contents and being antifungal against planktonic multi-resistant yeast pathogens like <i>Candida</i> species, <i>S. aureus</i> and <i>P. aeruginosa</i> microorganism cultures.	[23]
Sweet Relief: Determining the Antimicrobial Activity of Medical Grade Honey Against Vaginal Isolates of <i>Candida albicans</i>	2019	<i>Candida albicans</i>	50% of the honey based gel formulation proved to be antifungal against <i>C. albican</i> .	[24]

The information on the table above reflects some identified research that has been conducted on the antifungal potency of regular and natural honey against *Candida albicans*.

**Table 2. Physico-chemical characteristics of Brown sugar and regular bee honey**

<i>Parameter</i>	<b>Honey</b>	<b>Reference</b>	<b>Brown sugar</b>	<b>Reference</b>
<i>Appearance</i>	brown	This review	brown	This review
<i>pH</i>	3.76	[25]	4.64	[26]
	3.75	[27]		
<i>Moisture content (%)</i>	17.10	[28]	47	[29]
	18.5	[27]		
<i>Ash content (%)</i>	0.21	[27]	10.25	[30]
<i>Viscosity (Cp @ 10rpm)</i>		[31]	22.1	[29]
	10,000			
<i>Electrical conductivity( uS/cm)</i>	0.69	[27]	2.58	[25]
<i>Reducing sugar (%)</i>	66.41	[27]	17.80	[30]
<i>Free acidity(meg/kg)</i>	40	[27]	28.12	[33]
<i>Sucrose (%)</i>	4.48	[27]	32.10	[30]
<i>TDS(ppm)</i>	21.4	[25]	38	[29]
<i>HMF(mg/kg)</i>	36.35	[27]	14.15/17.8	[32]

The colour appearance of the two samples was physically deduced to be brownish. Both samples were acidic in nature. Moisture content with brown sugar was more than the honey sample. Meanwhile, the level of moisture content is a qualitative function of organic material with hygroscopic nature with honey and brown sugar. Generally, the

difference of 29.90% was estimated between honey and brown sugar. Ash contents are the illustration of the mineral compositions with the two samples. Honey and brown sugar are generally acidic due to the availabilities of organic acids that can be responsible for the anti-microbial and anti-fungal properties with the two. The level of viscosity with the

honey reveals its quality with time and a different margin of 977.9Cp against the brown sugar. The conductivities of the two samples are indications and capacities of ionizable organic components as electrolyte under atmospheric conditions. It is a function of the qualities of the two samples with a difference of 1.89(uS/cm) between honey and brown sugar. Reducing sugars are a degree of simple sugars that are present in the samples. It is with the difference of 48.61% between honey and brown sugar. Free acidities, TDS, and HMF differ by 11.88 meq/kg, 16.6ppm, and 22.20/18.55(mg/kg) between honey and brown sugar respectively.

## 2.0 CONCLUSION

The increase in Candida and Cryptococcus infections is alarming leading to high cases of death globally. Concomitantly with the increase in fungal infections, species emerged, and the resistance phenomenon increased so that the available antifungal properties becomes irrelevant in the face of the problem. In addition, there are limitations manifested by some agents with antifungal properties such as fungistatic character, severe toxicity, and renal dysfunction. Therefore, it is crucial to identify and discover new measures as alternative therapies that are potentially active against Candida species especially. Antifungal activities of different honey samples has been assessed through culture media with various concentrations of honey. Generally, the components in the honey samples are accountable with the antifungal properties in vitro. Honey having a related physical and chemical properties with brown sugar are considered abundant and safe sources of phytochemicals endowed with many biological activities. Brown sugar may be explored and studied to enhance their anti-fungal activities in obtaining promising, efficient, and cost-effective approach for the inhibition of Candida and other fungal infections.

## 3.0 RECOMMENDATIONS.

1. Further studies are, therefore, required to demonstrate the antifungal activity of brown sugar at clinical level.
2. Identification of the bioactive agents and pharmacological data are essential for validations
3. Further research is necessary to evaluate the effectiveness of brown sugar as an inhibitor of candida species in treating candidiasis.

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