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Stingless bee honey: A systematic review of the therapeutic potential and its nutraceutical properties

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Abstract

Stingless bee is an instinctive kind of bee that exists in nearly every region. The honey produced by this bee contains peculiar and divergent types of phenolic and flavonoid compounds of versatile biological and clinical significance. The peculiar attribute of this honey is that it is stored in the cerumen (Pot), thus affording to its benignant properties, particularly in the wound healing properties. Contemporary science has established that most conventional practise of using stingless bee honey has great prospective as enrich value in current medicine and deliberated to have a greater therapeutic value than other bee species. Whereas there are many stingless bee species that produce extensive of products, known since ancient in prescriptive medicine. At the same time, due to comparatively low production of honey compared to other honey, so target on this honey is narrowed. In consequence, this systematic review deals the futuristic result on the potential valuation of Stingless bee honey [SBH] as antimicrobial, antioxidant, anti-cancer, anti-diabetic, anti-inflammatory; the treatment of ocular diseases, fertility disorders and wound healing activities are delineated.

Keywords: stingless bee, therapeutic medicine, antimicrobial, antioxidant and wound healing

Introduction

Honey is a natural sweetener that is extensively attainable across the world [1], through natural products it is enormously used for varied applications, some clinical [2], and contains more or less 200 diverse chemical compounds [3]. Honey produced by Stingless bee is known with various names such as Meliponine honey, Stingless bee honey, Pot honey and also Kelulut honey [4]. It is one among the valuable bee products and is accredited with some medicinal properties by ancient folks [5].

Earliest study proved that SBH can act as Anti-inflammatory, anti-cancer, anti-microbial and possessed antioxidant properties [6]. Although, the advantages of SBH has been deserted in current medicine due to the lack of systematic scientific studies for supporting its medicinal properties [7]. The composition of SBH contrast from other species corresponding to some physiochemical parameters [8] and other studies demonstrate that honey from SB are more expensive and it has been used for a long time to cure variety of diseases [9]. Since from 20th century, numerous studies on the chemical and biological properties of honey had been preside over due to their remarkable anti-inflammatory, anti- bacterial, wound and sunburn healing effects [10].

New evidence designates that SBH has potential therapeutic advantages in several contexts [11]. Accordingly, nurturing the research on SBH would help to upgrade the knowledge on its putative medicinal properties and ensure the conservation of SBH trade [12]. The focus of this review is to summarize information on the traditional and clinical uses of SBH to elevate various biological activities and to treat diseases.

Taxonomical Classification

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Hymenoptera

Family: Apidae

Clade: Corbiculata

Tribe: Meliponini

Physiochemical constituents of Stingless bee honey

SBH is also known to be rich in minerals, enzymes, vitamins and amino acids with nearly 200 different compounds was reported [13]. Fructose is delineated as the most generous sugars found in SBH with near 31-39% of various sugars in honey [14]. Apart from fructose and glucose, various research had revealed the presence of various disaccharides and oligosaccharides in honey [15]. Minerals or trace elements adjacent in honey are magnesium, potassium, zinc, calcium, sodium, phosphorous, copper, sulphur, manganese and iron [16]. In addition numerous vitamins including ascorbic acid (Vitamin C), riboflavin (Vitamin B2). Thiamine (Vitamin B1), pantothenic acid (Vitamin B5), Pyridoxine (Vitamin B6), nicotinic acid and cyanocobalamin (B12) are present [17].

Various studies have reported that the antioxidant activity of

honey is depending on not only on the presence of total phenolic compounds but also on the presence of flavonoids which take part in an important role in enhancing oxidative stress [18, 19, 20, 21]. Enzymes and proteins are slight elements, with the enzymes playing a vital role in enormous activities, including antimicrobial activity and promoting calcium absorption [22]. The various physiochemical properties of SBH are tabulated in (Table 1). Enormous types of therapeutic efficacies of SBH are elucidated in (Figure 2).

Table 1: Physiochemical properties of Stingless bee honey [23]

S. No	Physiochemical properties	Values
1.	Appearance	Amber brown
2.	Moisture	25.02
3.	PH	3.05 – 4.55
4.	Total reducing sugar	55-86 %
5.	Glucose	8.20-30.98
6.	Fructose	31.11-40.20
7.	Sucrose	0.31-1.26%
8.	Ash content	1.01-0.12

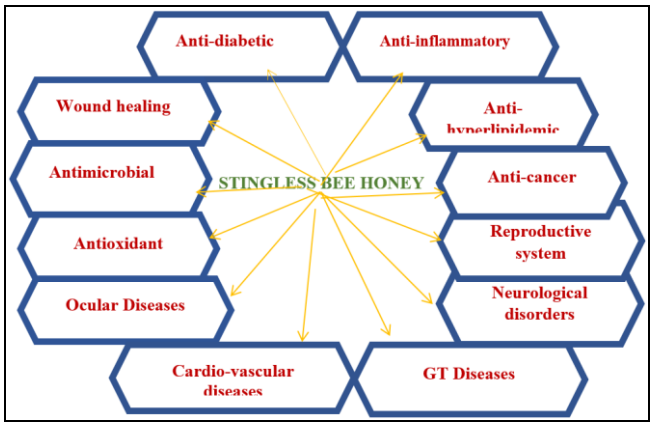

Fig 1: Schematic representation of therapeutic effects of honey

Wound healing activity of SBH

Honey has been attained to cure surgical wounds, septic wounds, wounds of abdominal wall and perineum owing to its outstanding wound healing properties. Formerly, it is also being used in curing burns, abrasion and amputation [24, 25, 26]. Large numbers of studies have explored the wound healing effects of honey. The wound healing activity of honey on experimental mice, which obtained contemporary application of honey, has been effective. Histopathology findings showed remarkable development in granulation tissue thickness and open wound size. This finding also proposed that the current application of honey to wounds may reveal a wound healing capacity [27]. A few *in vitro* studies disclosed the significant antimicrobial activity of SBH, which could also propose the feasible wound healing activity of this honey [28, 29, 30]. Honey is useful as wound dressing as it helps to restorative the healing process and can clear the infection rapidly for it depicts better cleansing activity. Apart from, it has demonstrating anti-inflammatory activity and plays a substantial role in invigorating tissue regeneration [31, 32].

Antioxidant activity of SBH

The antioxidant capacity assay for any product is established on the potential of the compounds to inhibit oxidation, thus reducing protection of free radicals that consequence in a chain reaction causing harmful cellular alterations [33]. Two varieties of SBH have been described to have virtuous antioxidant capacity [34]. A research carried in the North eastern regions of Brazil explored that SBH from *Melipona seminigramerillae* possesses antioxidant potential [35]. Many studies have designated that SBH from different geographical regions have enough but variable antioxidant activity [36].

The antioxidant effects of SBH have been shown in a study directed on a diabetic rat model. Animals go through treatment with SBH, Which bring about increased level of superoxide dismutase and glutathione (antioxidant enzymes) where as protein carbonyl and malondialdehyde levels diminished in their sperms and testis, thus enhancing the quality of their sperm [37]. One more study revealed that the potential increase in cell viability of lymphoblastoid cell line (LCL) might be regulated by the antioxidant properties of SBH [38]. Simultaneously these findings suggest that in a concentration depend manner, various antioxidant compounds of SBH could play a indispensable role in the increase of decline of cell viability by regulating oxidative stress and cytotoxicity.

Antimicrobial activity of SBH

The antimicrobial activities of SBH were delineated due to phytoconstituents, acidity, high osmolarity and the existence of nitrogen peroxide in the SBH [39]. The SBH has a wide spectrum of antibacterial cell because it can work against extensive range of bacteria, that able to cause disease [40, 41]. Majority of the studies of SBH were carried on *Staphylococcus aureus* showed that it is the most susceptible tested pathogen to SBH [42]. From the results of the studies revealed SBH can reduce the risk of infections to humans by this *Staphylococcus aureus*.

At the same time the SBH can dominant the food born infection by suppressing the food born organisms such as *E.coli* and *Staphylococcus aureus* [43]. SBH can also be reduced the infections time for ocular diseases caused by *Staphylococcus aureus* and *Pseudomonas aureus* [44]. Apart from SBH able to protect against Gastro intestinal infections in humans [45]. A recent study stated that the eleven types of SBH, inclusive of *Trigona carbonalia*, have significant antimicrobial activity against various types of microorganisms collected from thirteen clinical isolates in addition to standard reference strains [46].

Anti-inflammatory activity of SBH

Owing to their anti-inflammatory properties, SBH extracts have been used in the treatment of murine asthma model [47]. In this model, rats treated with SBH had lowered progression of allergic inflammation as shown by decreased total cell counts in the bronchoalveolar fluid, decreased peribronchovascular inflammation and inhibition of polymorphonuclear cells into the alveolar spaces. Other studies have shown same cytokine mediated anti-inflammatory activity, as SBH extracts lowered IL-6 expression on inflamed dental pulp tissues [48]. The protection of different inflammatory cytokines has been evaluated by revealing human monocytes to Manuka honey [49]. Tualang honey has been revealed to possesses anti-inflammatory potential in animals, the administration of tualang honey to a chemical persuade injury on rabbit cornea yielded effects similar to those of traditional treatment indicating its significance to treat aliments if the eye [50]. A honey extract from SB *in vivo* approaches thus,

terminated that the SBH able to decreased the effect of ear edema [51].

Antidiabetic activity of SBH

Inadequacy of insulin production by the pancreas, hyperglycaemia and unbalanced lipid profiles are the characteristics of chronic metabolic disorders, diabetic mellitus [52]. Various studies have revealed the anti-diabetic potential of honey specifically from SBH. Alpha amylase and alpha glucosidase are the two important enzymes that intricated in increasing of blood glucose level. The inhibition of these enzymes designates as better anti-diabetic potential as it helps to lower the blood glucose level. The anti-diabetic properties of SBH was analysed using in invitro alpha amylase and alpha glucosidase enzymes inhibition assays, whereby SBH was found to exhibit the inhibition of both enzymes [53]. The complex starch molecule will be converted into mono sugars by these enzymes; so that an ambitious inhibition between alpha amylase and alpha glucosidase with the phytoconstituents in the honey could prevent the increase of blood glucose level at a faster rate [54]. SBH also exhibited excellent anti-diabetic potential *in vivo*, where administration of this honey to diabetic induced male rats did not raised the level of fasting blood glucose, low density lipoprotein and total cholesterols [55].

Effects on Ocular Diseases

SBH besides plays vital role in treating chemically persuaded cataracts. And also SBH drop was applied an selenite induced rats and had emerged in lowering the rate of the cataract process in 20% of the rats in the group that received honey for the opacification treatment [56]. In spite of that SBH was also demonstrated to reduce the infection time for ocular disease caused by Pseudomonas aeruginosa, *Staphylocoocus aureus* along *in vivo* studies using rabbit as the animal model [57]. Furthermore, SBH has been used as an eyedropper to treat eyesight complications. It is also used to treat Glaucoma and cataracts [58].

Effects on Fertility

Honey has valuable effects on fertility as well as in ameliorating the hormones related fertility. It has been manifest to portray significance effects on fertility by means of augmenting the hormones related to fertility [59]. A recent reports on rat exposed to auditory stress resulted that a decrease in fertility would be ameliorated with 0.2ml of 5% honey dissolved in water. This study resulted that SBH consumption ameliorated altered the levels of follicle inducing hormones (FIH), Luteinizing hormone (LH) and testosterone. And also positive effects of Vitamin E on the parameters have been recorded [60].

In recent times, the crucial role that stress plays a vital role in many problems, diseases and dysfunction. Modifications in reproductive functions are a common attribute of increased levels of stress. One of the studies reported, the administration of SBH to prudence stressed pregnant rats at 1.2gm/kg daily conferred beneficial effects on different parameters, such as corticosterone level pregnancy outcome and adrenal histomorphometry [61].

Conclusion and future prospects

This current review exhibited a potential role of the SBH as a therapeutic agent in numerous health problems such as wound healing, anti- diabetic, anti-cancer, anti- oxidant, anti-microbial, ocular and also in fertility treatment. Various types of honey have been explored for their wound healing, anti- diabetic, anti-cancer, anti- oxidant, anti-microbial activity. Regrettably, research on Stingless bee honey has not been conducted consistently, very few information is obtainable. Therefore, innovative efforts should be taken to fully explore and utilize these benefits. So this review article makes explicit the need for evaluation of the significant biological and therapeutical activities of SBH including in the treatment of many diseases.

Conflict of Interest

The author's declared that they have no conflict of interest

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