Review Article

A study of health benefits,chemical composition and biochemical activities of natural honey

Natural honey beneficial to health, its chemical composition, and biochemical activities– A study

Abstract

Since early antiquity, honey has been utilized worldwide as a balanced meal and in supplementary treatment. It contains over 200 different substances, the majority of which are water, sugars, vitamins, enzymes, amino acids, minerals and phytochemicals. It has health advantages, including microbial inhibition, healing, and its influence on other disorders. Additionally, it stimulates the immune system and helps immune cells mature. The nutritional value of honey is substantially influenced by the type of plants in the region, the climate, and the production process. Different types of honey were examined by various workers and they found a strong relationship between honey type and HMF, saccharose, and phenolic content, as well as acidity and antioxidant activity. For the level of vitamin C, glucose, and fructose, the combination of variety and manufacturing technique has a substantial influence. The focus of this study is on the biochemical processes and its potential health benefits. However, the precise mechanisms of honey's influence on many illnesses and activities have not yet been fully defined, and more study is necessary to understand their precise contributions.

Keywords: Honey, Composition, Antioxidants, Atherosclerosis, Inflammation, immune system.

Introduction

A sweet liquid produced by the honey bees is called honey. Honey is well-known on a global scale since it contains several nutrients that are good for people's health. Egyptians, Greeks, Romans, and Chinese people have all utilized it in the past to treat gastrointestinal injuries and illnesses, such as stomach ulcers. Additionally, it has been employed as a treatment for earaches, sore throats, and coughs [1]. Honey is used internally [2] as a functional meal to offer energy and nutrients to improve critical the body's organs [3] in addition to being utilized externally. This has been done since the start of history. The quality of honey is

significantly influenced by its active ingredients, which include organic acids, flavonoids, polyphenols, glucose, and fructose [4]. Due to its useful qualities and nutritional benefits, honey is produced in many nations across the world and is acknowledged as a significant food that provides energy as well as a treatment. Furthermore, the biochemical, physiological, and pharmacological properties of honey are well established.

Apiculture is the study and practice of employing substances from honeybee colonies, such as honey, bee bread, bee venom, bee pollen, propolis and royal jelly, to maintain, lengthen, and prolong life. Bee products have been rapidly incorporated into both conventional and contemporary medicine in recent years. Due to their effectiveness, bee products are currently the subject of several research aimed at determining their specific health benefits and pharmacological qualities, which has accelerated the creation of nutraceuticals and functional foods derived from these products. Functional food is defined as food that, when compared to conventionally remediated and nutritive food, can promote improved physiological or psychological health. These outcomes favourably impact great health preservation, wellbeing, and a decrease in chronic disease [5].

Due to its useful qualities and nutritional benefits, honey is produced in many nations across the world and is acknowledged as a significant food that provides energy as well as a treatment. Furthermore, the biochemical, physiological, and pharmacological properties of honey are well established. The biochemical functions, prospective health advantages, and effects of chemical contaminants in honey are the main areas of this review.

2. Chemical Composition of Honey

Each floral source has a unique honey composition, but then again seasonal, environmental factors and processing conditions are similarly significant. More than 200 bioactive compounds are present. Some other term for honey is "supersaturated sugar solution." Natural honey has 82.4% of its mass in carbohydrates, 38.5% in fructose, 31% in glucose, 12.9% in other sugars, 17.1% in water, 0.5% in protein, organic acids, multimineral, amino acids, vitamins, phenols, and a plethora of other minor constituents. The ratio of one form of sugar to another is influenced by the source, such as floral pastures, and to a lesser measure by the enzyme invertase, which dissolves normal sugar in grapes and other fruits. This enzyme can be found in the flower where the bees get their nectar, but it is also in the bee itself [6].

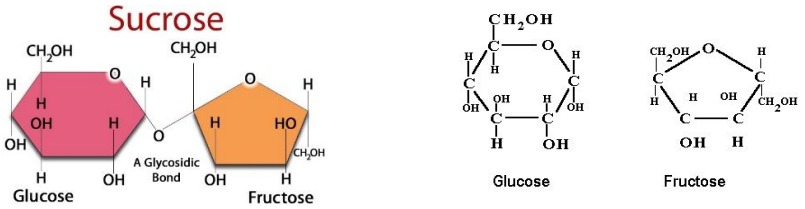

Figure A - Structure of sucrose, glucose and fructose.

Honey contains 76% sugars (34% glucose, 40.5% fructose, 1.9% sucrose) and 5.5% other carbs. While rape seed honey stands out for having a larger amount of glucose, acacia and chestnut honey are both quite high in fructose. Numerous studies on the fructose/glucose ratio of different honey samples have been undertaken, discovered that samples of honeydew honey from Croatia had slightly more fructose content (32.4%) than glucose (31.0%), whereas samples from Macedonia had more glucose (36.8%) than fructose (33.6%). According to Ahmed et al. (2014), four samples of honey from various locations in western Algeria range were taken, the glucose and fructose concentration are found from 21.45 to 28.26 g/100 g and 25.20 to 37.64 g/100 g, respectively [7-10]. With a range of 15 to 23%, water is the second-most significant component of honey. The amount of water in honey affects its viscosity, specific weight, maturity, flavour, and crystallization, and is influenced by the weather, the type of bees, the strength of the bee colonies, the humidity and air temperature in the hive, the processing and storage conditions, and the honey's botanical origin.

Due to its hygroscopicity, honey contains a variable amount of water that varies throughout storage according on the air's humidity. Because it affects the stability and resistance of honey to microbiological degradation during storage, it may be claimed that the amount of water in honey plays a significant role in defining both its quality and durability. The probability of fermentation increases with water content [11][12]. Because nectar and pollen are essential components of plants, proteins can be found in honey. Proteins in honey can take the form of simple substances like amino acids or very complicated structures [13]. Protein and amino acid content together make up no more than 0.7% of the total. Nearly all amino acids that are crucial for health are present in honey. Proline, the primary amino acid, is used to gauge how ripe honey is. Normal honeys should include more than 200 mg/kg of proline. Values below 180 mg/kg indicate that the honey has likely been tampered with by the addition of sugar [14].

The components that give honey its scent is known as honey volatiles. Early in the 1960s, studies on honey volatiles were initiated. The majority of volatile chemicals are most likely derived from plants, although some of them are also likely to be bee-added, according to recent research [15] of volatiles recovered from honey. A large number of chemicals have been identified in various honeys up to this point. Secondary metabolites generated from plants include polyphenols and phenolic acids. In plant systematics, these substances have been employed as chemotaxonomic markers. They have been proposed as potential indicators for identifying the honey's botanical origin [16]. According to reports, dark-coloured honeys contain less flavonoids and more phenolic acid derivatives than light-coloured ones [17].

Mineral compounds are present in honey in various concentrations. In addition to several other components, potassium is the major element in honey (Table 1). The main mineral element is potassium, which makes up an average of around one third of the total, however there are many different trace elements. Numerous studies have revealed that the trace element composition of honey is mostly influenced by its botanical source. 3.68% or so are in minerals [18]. Minerals in honey increase the value of honey for human consumption even if this portion of the honey is not produced in great quantities. The majority of minerals, including potassium, chlorine, sulphur, calcium, sodium, phosphorus, magnesium, silicon, iron, manganese, and copper, are found in honey [19]. Darker honey varieties contain more minerals than lighter ones when compared to the observed mean value. Of course, a darker species can be found that is less wealthy than some lighter species [20-23].

Table-1. Chemical composition of honey per 100 g

Minerals		Average amount present in mg
	Calcium	4-30
	Chlorine	2-20
	Zinc	0.05–2.00
	Sodium	1.6–17.0
	Copper	0.02–0.60
	Iron	0.03–4.00
	Magnesium	0.7-13

	Phosphorous	2 – 15.0
	Selenium	0.001–0.003
	Potassium	40.0–350.00
Proximate (g)		
	Fructose	38.2
	Glucose	31.3
	Sucrose	0.7
	Other disaccharides	5.0
	Organic acids	0.5
	Proteins, amino acids	0.3
Vitamins (mg)		
	Ascorbic acid	2.2–2.5
	Thiamin	0.0–0.01
	Riboflavin	0.01–0.02
	Niacin	0.1–0.2
	Pantothenic acid	0.02–0.11
	Pyridoxine (B6)	0.01–0.32

3. Bioactive Compounds in Honey

Honey has a lot of beneficial chemicals (Table 1). Bioactive substances include both essential and non-essential elements found in food chains, such as polyphenols and vitamins. These substances are naturally occurring in food and offer advantageous health advantages. Bioactive substances include phenolic compounds. When there are appropriate functional derivatives present, phenols are described as organic compounds having an aromatic ring that is chemically linked to one or more hydrogenated substituents [24] Honey also contains trace levels of beneficial substances as phenolic acid, flavonoids, and tocopherol [25]. The antioxidant, antibacterial, antiviral, anti-inflammatory, anti-fungal, wound-healing, and cardioprotective effects of phenolic compounds, among others, contribute to the functional qualities of bee products [26]. Phenolic acids, flavonoids, ascorbic acid, proteins, carotenoids, and specific enzymes like glucose oxidase and catalase are among the components of honey that have positive health effects [27].

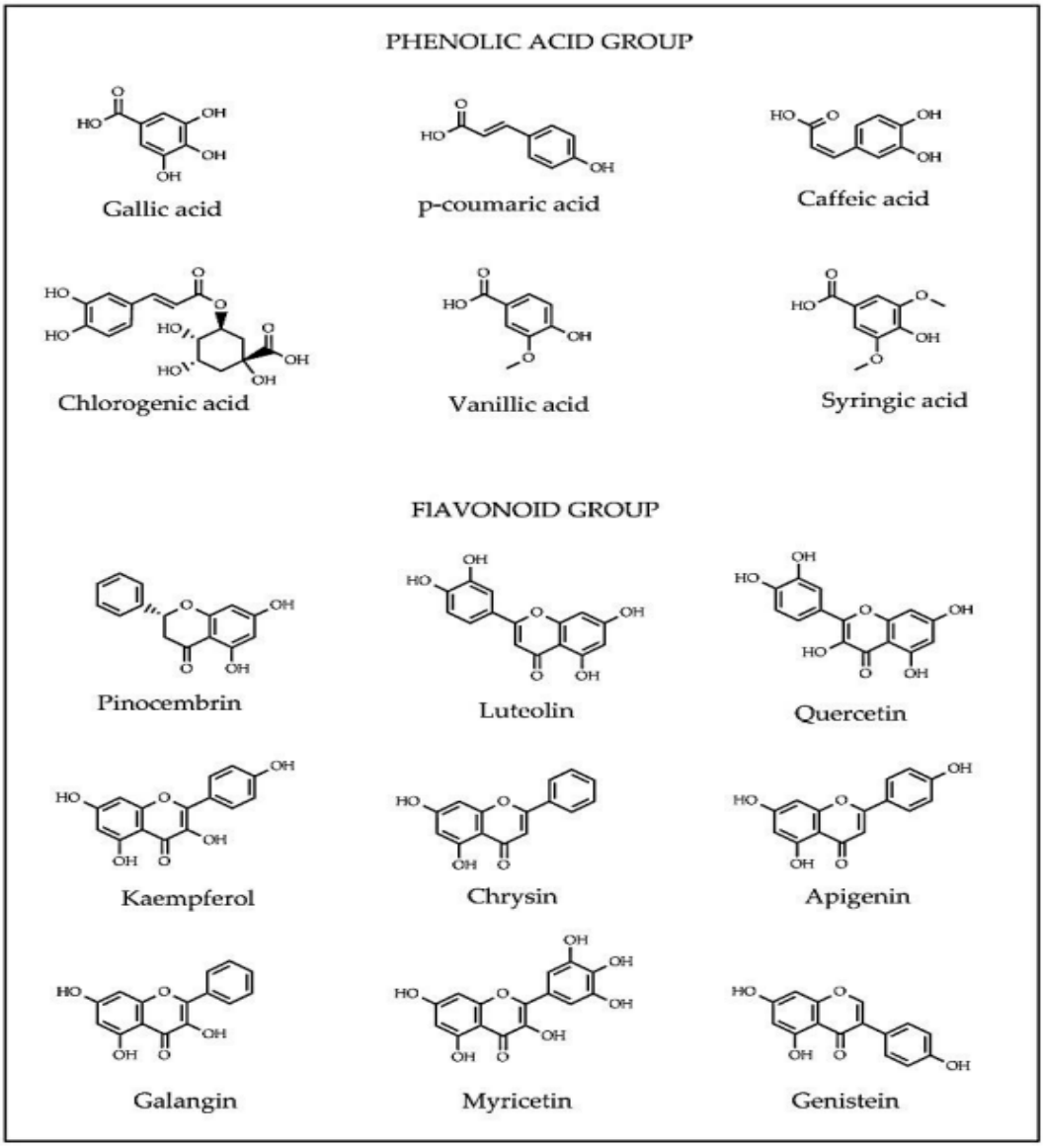

Figure - B. Bio actives common phenolic acid and flavonoid compounds identified in honey.

According to the quantity of vitamins, minerals, antibiotic-rich inhibin, carotenoids, free amino acids, enzymes, proteins, Maillard reaction products, and phenolic compounds present in honey composition, the non-sugar components, though present in minor quantities, define a specific type of honey and are bioactive [28]. Flavonoids (apigenin, chrysin, galantine, hesperidin, kaempferol, luteolin, myricetin, and quercetin), which are typically heterocyclic ring compounds, are made up of two aromatic rings connected by a carbon bond. Different

flavonoid classes, such as flavanols, flavones, flavanones, flavanols, isoflavones, flavanonols, and anthocyanidins, result from variations in the heterocyclic ring compounds. Ring substitutions result in a variety of molecules for each flavonoid family [29]. Phenolic chemicals exert antioxidant capacity (AOC) in a variety of ways, such as metal chelators, free-radical scavengers, or gene modulators of enzymatic and non-enzymatic systems that control cellular redox balance, depending on the molecular structures [30]. A particular phytochemical or mixture of them may be able to identify the location and type of plant from which honey was made [31][32]. Manuka honey, citrus honey, sunflower honey, and lavender honey, among others, all contain methylglyoxal, as do hesperidin, quercetin, and luteolin [33–36].

4. Health Benefits of Honey

4.1. Wound Management.

Honey has long been used as a remedy for boils, ulcers, burns, insect bites, and skin conditions. The effectiveness of honey as an antibacterial agent and a stimulator of wound regeneration have been supported by scientific research [37]. In the wound matrix, honey encourages the activation of dormant plasminogen, which leads to the dynamic expression of the proteolytic destructions. It is an enzyme that disintegrates fibrin clots in the wound bed that have attached dead tissues [38]. Clinical evidence supporting the effectiveness, specificity, and sensitivity of honey in wound care shows that the performance of conventional and modern wound care dressing is inferior to that the use of honey [39]. Sure, instances have proven that honey stimulates wound-recuperation houses even in infected wounds that do not respond to antiseptics or antibiotics and wounds that have been inflamed with antibiotic-resistant bacteria, which include methicillin-resistant Staphylococcus aureus (MRSA). Honey also aids autolytic debridement and hastens the boom of wholesome granulated wound bed [40]. Malodour is a standard attribute of extreme wounds because of anaerobic bacterial species belonging to Bacteroides spp. and Pepto streptococcus spp. [41]. Malodourous compounds, which includes ammonia, amines, and sulphur, are produced via microorganism during the metabolism of amino acids from putrefied serum and tissue proteins. These compounds are changed by means of lactic acids as honey dispenses a tremendous quantity of glucose, a substrate metabolized by using microorganism in choice to amino acids [42]. The therapeutic results discovered after honey software consist of fast

healing, wound cleaning, clearance of contamination, tissue regeneration, minimized irritation, and expanded consolation all through dressing because of lower extent of tissue adhesion [43].

4.2. Paediatric Care.

Honey also controls skin harm close to stomas, along with ileostomy and colostomy, by way of improving epithelialization of the afflicted skin floor [44]. Honey has a useful impact on paediatric dermatitis because of excessive use of napkins and diapers, eczema, and psoriasis. The effect of honey blended with beeswax and olive oil changed into investigated on patients with psoriasis or atopic dermatitis condition. A scientific trial showed that a mixture containing honey turned into extraordinarily properly tolerated and brought about full-size improvements. Honey consists of various nitric oxide metabolites, which lessen the occurrence of pores and skin contamination in psoriasis [45].

4.3. Oral health.

Honey is useful for the treatment of many oral diseases, including periodontal disease, stomatitis, and halitosis. In addition, it has also been applied for the prevention of dental plaque, gingivitis, mouth ulcers, and periodontitis. The antibacterial residences of honey can stimulate the growth of granulation tissue, main to the repair of broken cells [46]. Honey exerts antimicrobial hobby towards this anaerobic micro-organism and forestalls periodontal ailment [47]. Inflammation of mucous membranes inside the mouth (stomatitis) may induce redness and swelling of oral tissues and purpose distinct and painful ulcers. Honey penetrates into the tissues in no time and is powerful towards stomatitis [48, 49]. Halitosis is an oral health situation that reasons malodorous breath. Most of the odour within the oral cavity is because of the hobby of degrading microbes [50]. A current takes a look at has stated that honey consumption ameliorates halitosis due to its strong antibacterial activity due to its methylglyoxal component [51].

4.4. Gastrointestinal (GI) disease.

Herbal honey is composed of enzymes that facilitate the absorption of molecules, including sugars and starch. The sugar molecules in honey are in a form that can be without difficulty absorbed by using the frame. Honey also provides a few nutrients, such as minerals, phytochemicals, and flavonoids, that useful resource digestive technique within the body [52]. Natural honey has bactericidal properties towards pathogenic micro-organism and input pathogens, consisting of *Salmonella spp*., *Escherichia coli, Shigella spp*., and plenty of

different Gram-negative species [53]. The gastrointestinal tract (GIT) includes many vital beneficial microbes. For example, Bifidobacteria is one of the microorganisms present in the main for the sustenance of a healthy GI gadget. It has been cautioned that consuming meals wealthy in probiotics can growth the populace of Bifidobacteria within the GIT. The organic activities and development of this microorganism are similarly more advantageous in the presence of prebiotics. Research has shown that herbal honey consists of excessive amount of prebiotics [54]. Some in vitro and in vivo experimental trials on honey have pronounced it as a prominent dietary supplement that accelerates the boom of Lactobacillus and Bifidobacteria and catalyses their probiotic potency within the GIT [55, 56]. Below in vitro situations, prebiotic substances in honey inclusive of inulin, oligofructose, and oligosaccharides promoted the growth within the numbers of *Lactobacillus acidophilus and L. plantarum via* 10–one hundred folds, which became beneficial for the intestinal microbiota [57].

4.5. Dyspepsia, Gastritis, and Peptic Ulcer.

Dyspepsia is a continual ailment in which the GI organs, especially the stomach and first part of the small gut, function abnormally. It is a ailment that causes epigastric ache, heartburn, bloating, and nausea as symptoms. Dyspepsia is the preliminary symptom of peptic ulcer that could in the end motive cancer. Gastritis refers to the infection and irritation of the lining of the stomach wall. Peptic ulcer denotes erosions or open painful ulcers at the lining of the stomach or duodenum. Honey has been identified as a robust inhibitor for gastritis and the peptic ulcer inflicting agent, *Helicobacter pylori (H. pylori*) [58]. Clinical surveys have shown that honey decreased the secretion of gastric acid and elevated the healing impact. Thus, honey is taken as a nutritional supplement for its antibacterial homes and protecting impact [59]. The high sugar content and low pH in honey are the results of glucose oxidative conversion to gluconic acid with the aid of glucose oxidase. This mechanism releases hydrogen peroxide, which functions as an antibacterial agent. Glucose oxidase also acts on fibroblasts and epithelial cellular activators required for the recovery of ulcers due to *H. pylori* [43-44].

4.6. Gastroesophageal Reflux ailment.

Gastroesophageal reflux ailment (GERD) is a mucosal contamination caused by contents of bizarre gastric reflux into the oesophagus or even the lungs. Symptoms of GERD consist of heartburn, inflammation, and acid regurgitation. Consumption of honey helps this condition through coating the oesophagus and stomach lining, hence preventing the upward waft of

meals and gastric juice. Honey can in addition stimulate the tissues at the sphincter to assist in their regrowth and eventually lessen the probabilities of acid reflux disease [60].

4.7. Constipation and Diarrhoea.

Persistent constipation is a not unusual and multifarious contamination characterised via intolerable defecation (irregular stools and tough stool passage). Tough stool passage includes symptoms such as straining, tough to expel stool, a sense of incomplete evacuation, tough or lumpy stools, and prolonged time to skip stool [61]. Diarrhoea is described as a high frequency of bowel movements with watery stool. Honey has minimized the pathogenesis and period of viral diarrhoea in comparison to conventional antiviral remedy [62]. In every other case, humans diagnosed with inflammatory bowel syndrome (IBS) experiencing excessive diarrhoea or constipation, bloating, and stomach soreness turned into efficiently dealt with uncooked Manuka honey on an empty stomach [63].

4.8. Pharyngitis and Coughs.

Pharyngitis, normally known as sore throat, is an acute contamination prompted by Streptococcus spp. in the oropharynx and nasopharynx [64]. Similarly, to streptococci, viruses, no streptococcal microorganism, fungi, and irritants together with chemical pollutants may additionally reason sore throat. Manuka honey is powerful for treating sore throat with its antiviral and antifungal properties. Honey coats the inner lining of the throat and destroys the dangerous microbes at the same time as simultaneously soothing the throat [65, 66]. A survey has validated that honey is advanced to different remedies for cough brought about with the aid of upper respiration infections, which includes dextromethorphan and diphenhydramine [67]. The antioxidant and antimicrobial homes of honey aided in minimizing continual cough and ameliorated sleep for both kids and adults following honey consumption (2.5 ml). A comparative has a look at on children with exclusive herbal merchandise reported that honey changed into discovered to be the broadly used remedy for pneumonia 82.4% [68].

4.9. Metabolic and Cardiovascular fitness.

Herbal wild honey exerts cardioprotective and therapeutic influences in opposition to epinephrine-brought on cardiac disorders and vasomotor dysfunctions. A harmonized courting among radical scavenging interest and the full phenolic content material of honey has been discovered [69]. Honey consumption confirmed a large discount in threat elements of metabolic and cardiovascular illnesses. Honey reveals cardioprotective consequences

together with vasodilation, balancing vascular homeostasis, and upgrades in lipid profile [70]. Flavonoids in honey improves coronary vasodilation, decreases the capability of platelets to form clots, prevents oxidation of low-density lipoproteins (LDL), will increase high-density lipoproteins (HDL), and improves endothelial functions [71]. A have a look at conducted to examine the metabolic reaction of honey has indicated its ameliorative outcomes towards metabolic syndromes (MetS) [72]. MetS is denoted via hyperglycaemia, high blood pressure, belly weight problems, dyslipidaemia, and intensified adaptability closer to diabetes, kidney, and coronary heart diseases. Polyphenols in honey lessen atherosclerotic lesions via the downregulation of anti-inflammatory and angiogenic mechanisms [73]. A clinical take a look at carried out on patients with hyperlipidaemia showed that honey reduced total cholesterol (TC) and extraordinarily avoided the upward push in plasma glucose tiers. Nitric oxide (NO) is a metabolite found in honey that still has cardioprotective features [74].

4.10. Gastroenteritis.

Gastroenteritis, referred to as stomach or gastric flu, causes inflammation of the digestive tract. This situation can be because of food borne, waterborne, and man or woman-to-man or women unfold of infectious sellers. The signs of gastroenteritis consist of dehydration, watery diarrhoea, bloating, abdominal cramps, and nausea. There are numerous infectious dealers, consisting of Salmonella, Shigella, and Clostridium, which could reason this situation [75]. A clinical look at with the aid of Abdulrahman, 2010, has stated the remedy of infantile gastroenteritis the use of honey. The look at observed that changing the glucose in general electrolyte oral rehydration answer (ORS) with honey decreased the recovery time of sufferers with gastroenteritis due to the fact the excessive sugar content material in honey boosts electrolyte and water reabsorption inside the gut [76].

4.11. Diabetic Foot Ulcer (DFU).

Consumption of honey is a low-fee and effective remedy for the remedy of DFU. DFU is regularly complex by using microbial infections and slows the recuperation system. Apart from the contamination, symptoms along with ache, swelling, and redness may not be gift for diabetic peripheral neuropathy patients due to their decreased immune response, which similarly complicates the prognosis [77]. An overview indicated that using honey for the remedy of venous ulcers yielded wonderful outcomes with suitable acceptance costs from the sufferers [78]. Honey is utilized in wound control and is powerful amongst sufferers with domestically inflamed wounds, DFU, Charcot foot ulcerations, and complicated comorbid

conditions which have failed sanatorium control [79]. Similarly, there's terrific tolerability and minimum trauma to the wound mattress in the presence of honey.

4.12. Liver and Pancreatic sicknesses

Honey helps to appease ache, balance liver structures, and neutralize pollutants. Headaches inside the liver machine may be attributed to oxidative damage. Honey exhibits antioxidant activities which have a ability protecting impact on the damaged liver. A take a look at on paracetamol-prompted liver damage rats showed that the antioxidant and hepatoprotective activity of honey minimized liver damage. Honey, which has a 1: 1 ratio of fructose to glucose, may additionally help to sell higher blood sugar stage, that's useful for those laid low with fatty liver sickness because it provides ok glycogen storage in liver cells. Inadequate glycogen storage inside the liver releases strain hormones that impair glucose metabolism through the years. Impaired glucose metabolism leads to insulin resistance and is the primary thing of fatty liver sickness. Every other study suggested extensive discount in blood glucose ranges after remedy with Tualang honey [80-82].

5. Cancers and Oncogenesis

5.1. Colorectal cancer.

Maximum colorectal cancers begin as a polyp, which normally starts at the inner lining of the colon or rectum and grows toward the middle. A few polyps are not dangerous but some will subsequently grow into adenomas and might ultimately result in most cancers. A study that investigated the chemo preventive effects of Gelam and Nenas monofloral honeys in opposition to colon cancer cellular traces discovered that the honey inhibited proliferation of colon most cancers cells. Hydrogen peroxide-triggered infection in the colon most cancers cells turned into used to study the effect of honey. The results showed that honey curbed inflammation inside the cancerous cells. Every other study changed into finished to research the apoptotic consequences of crude honey on colon most cancers cell lines. The workers confirmed the antiproliferative impact of honey in those cells. Further, at excessive phenolic concentrations (such as the ones of quercetin and flavonoids), large antiproliferative movement against colon cancer cells became located. The molecular mechanisms resulting within the antiproliferative and anticancer results of honey include mobile cycle arrest, activation of mitochondrial pathway, induction of mitochondrial outer membrane

permeabilization, induction of apoptosis, modulation of oxidative pressure, reduction of inflammation, modulation of insulin signalling, and inhibition of angiogenesis in most cancers cells (discern 2). In addition, honey indicates ability results on cancer mobile via modulating proteins, genes, and cytokines that promote cancer. Several components of honey inclusive of chrysin, quercetin, and kaempferol have been shown to arrest cell cycle at various levels consisting of G0/G1, G1, and G2/M in human cancer, renal, cervical, hepatoma, colon, and oesophageal adenocarcinoma cell traces. The mitochondrial pathway involves a sequence of interactions among stimuli together with nutrients, bodily pressure, oxidative pressure, and damage throughout primary most cancers remedies including chemotherapy and radiotherapy. Those stimuli motive several proteins located in the intermembrane space (IMS) of the mitochondria, including cytochrome c, to be launched, which in the end culminates in the demise of the cellular. Flavonoids in honey are powerful in activating the mitochondrial pathway and discharging proteins with ability cytotoxicity. Induction of mitochondrial outer membrane permeabilization (MOMP) is the most normal anticancer mechanism, which causes the leakage of proteins from the IMS and inevitably results in cell death. Honey induces MOMP in most cancers mobile strains via reducing the mitochondrial membrane potential. Honey has additionally been documented for amplifying the apoptotic impact of tamoxifen by using intensified depolarization of the mitochondrial membrane. Flavonoid elements of honey, such as quercetin, have been proven to cause MOMP and result in most cancers mobile dying [83-85].

5.2. Liver Cancers.

The maximum not unusual form of liver cancer is hepatocellular carcinoma (HCC). The antitumor results of honey on liver cancer cells were investigated in diverse experimental studies. Treatment of HepG2 cells with honey minimized the quantity of nitric oxide (NO) degrees in the cells and decreased the HepG2 cellular wide variety greatly. This elevated the general antioxidant profile of the cells. The survival of HepG2 cells is promoted by means of reactive oxygen species (ROS), and good enough ranges of ROS trigger cell proliferation and differentiation. Lowering the amount of NO on account of honey remedy supported this have a look at. For this reason, decreased ROS and more desirable antioxidant efficacy inhibit cancerous cellular proliferation and decreased the quantity of HepG2 cells. Another study finished by way of Abdel Aziz *et al*. investigated the effects of honey on HepG2 cell lines. The record showed that honey exerted cytotoxic, antimetastatic, and antiangiogenic consequences on HepG2 cells primarily based on exceptional concentrations [81][83][86].

5.3. Breast cancer.

Imbalance in oestrogens signalling pathways and propagating degrees of oestrogens have critical roles in breast cancer growth and propagation. Treatments for breast cancer are related to focus on the oestrogens receptor (ER) signalling pathway. Phytoestrogens are a subclass of phytochemicals with a commonplace shape to the mammalian oestrogens that permits them to bind to oestrogens receptors. Several experimental researches have investigated the efficiency of honey in modulating the ER signalling pathway. Any other examine has proven that honey has biphasic hobby in MCF-7 cells. This biphasic activity of honey is represented with the aid of an antiestrogenic effect at lower concentrations and an estrogenic effect at higher concentrations that is brought on when phytoestrogens bind to oestrogens receptors. Moreover, quercetin has been pronounced to induce apoptotic consequences via ER α- and ER β-structured mechanisms. Alternatively, cytotoxic activities of Tualang honey in human breast cancer cells were verified by means of accelerated secretion of lactate dehydrogenase (LDH) and further illustrated the cytotoxic homes of honey. The observe also confirmed that honey handiest exerts cytotoxic results on breast cancer line and no longer on non-malignant breast cells. Therefore, this shows that Tualang honey indicates quite precise and selective cytotoxic results towards breast cancer cellular strains and has a very good potential as a chemotherapeutic agent [86-89].

6. Conclusion

The current review focuses on the potential health benefits of honey. It is very rich in bioactive components such as flavonoids, phenolic acids, phenolic compounds, terpenes and enzymes, and it prevents several diseases, has health-promoting biological functions. Honey has a wide range of benefits and has important nutritional properties and functional value. In this way, honey can be developed into a potent non-therapeutic drug. In conclusion, the complexity and variability of honey composition rely on its botanical and geographic origin. Each component has a specific role in nutrition, biology, and technology. They work together to increase honey's overall usefulness, making it special and superior to other natural sweeteners in terms of supplying energy and health advantages.

7. Abbreviation

5-hydroxymethylfurfural - HMF
Gastrointestinal tract - GIT
Gastroesophageal reflux ailment - GERD
Inflammatory bowel syndrome - IBS
Low-density lipoproteins - LDL
High-density lipoproteins - HDL
Metabolic syndromes - MetS
Total cholesterol - TC
Nitric oxide - NO
Oral rehydration answer - ORS
Diabetic Foot Ulcer - DFU
Intermembrane space - IMS
Mitochondrial outer membrane permeabilization -MOMP
Hepatocellular carcinoma -HCC
Reactive oxygen species - ROS
Oestrogens receptor - ER
Lactate dehydrogenase - LDH

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