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Honey And Its Health Benefits.A Review

Mushtaq Ahmad Beigh[1], Aaruba Maqbool Sofi[1], Nazrana Rafique Wani[1], Adnan Nazir, Gazanffar, Reyaz Ahmad Lone

[1]Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technolgy, Srinagar, Jammu & Kashmir,190025, India

Abstract

Natural honey has been used as food and medicine by humans from the dawn of time; raw honey is the oldest sweetener, and it was discovered to be in use over the world several million years ago (White et al.,2000). Natural honey is a sweet, flavorful liquid food with great nutritional content (Bogdanov 2008) that is generated by honeybees as blossom honey by secreting nectar from flowers, and honeydew honey (forest honey) by secreting plant sucking insect exudates (Aphids). Honey was suggested by Islam as a food and medicine, and an entire chapter in the Holy Qur'an was named Surah al-Nahl, which translates to "Chapter of the Honey Bee."

Honey is mostly composed of sugars, but it also contains acids, nitrogenous chemicals, phenolic compounds, HMF, minerals, and water. According to the research, honey composition is largely determined by the floral source and varies by kind. All generations, customs, and civilizations, both ancient and modern, recognise natural honey as nourishment and medicine. Its usage as a neutraceutrical agent has been linked to nutritional and therapeutic effects (Ajibola et al.,2012) Nutritional profiles, as well as health indices, have been documented in several literatures, including their use in newborn and child feeding. Adulteration of honey is a difficult issue with considerable economic implications as well as proven nutritional and organoleptic ramifications.

To ensure the authenticity of the honey, advanced analytical procedures such as GC (Gas Chromatography), LC (Liquid Chromatography), LCIRMS (liquid chromatography carbon isotope ratio mass analysis), and EAICRMS (Elementary Analysis carbon isotope ratio mass analysis) are utilised. Honey is high in prebiotics, probiotics, antibacterials, and other nutrients that are good for your health. It's a true functional food with numerous advantages.

Introduction

Honey is a natural sweet substance produced by honeybees from plant nectar, secretions of living parts of plants, or excretions of plant-sucking insects on living parts of plants, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store, and leave to ripen and mature in honeycombs.

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Honey is made by honey bees from two different sources: nectar and honeydew. The nectar is secreted in the nectary of the flower. It's a sugar solution with concentrations ranging from 5% to 80%. Sugars make up around 95% of the dry matter, with the rest consisting of amino acids (about 0.05%), minerals (0.02-0.45%), and trace amounts of organic acids, vitamins, and fragrance compounds. The sugar value of a plant, as assessed by the amount of sugar released by particular plants, determines its worth for bees. The sugar content varies greatly, ranging from 0.0005 to 8 mg. The main sugars are fructose, glucose, and sucrose, and each plant species has its own sugar composition.The nectar of most plants is primarily made up of fructose and glucose (rape, dandelion). Plants of the Fabiaceae and Labiateae families (acacia, clover, sage, and lavendel) produce nectar that is mostly sucrose. The concentration of sugar is affected by a variety of climatic conditions such as temperature, soil, humidity, and season. When the humidity is higher, the amount of nectar produced is larger, but the sugar concentration is lower. Temperature plays a significant influence as well. Temperatures between 10 and 300 degrees Celsius are ideal. Strong winds reduce nectar production. The secretion of nectar is also affected by the time of day. The peak times for secretion are around lunchtime and early afternoon. Bees prefer nectar with a greater sugar level, such as around 50%, and will not forage if the sugar content is less than 5%.Bees collect nectar to meet their energy requirements. The higher the sugar content of a plant, the more bees will visit it for foraging. It is impossible to predict nectar production due to the various secretion factors. Pollen analysis can be used to determine the botanical origin of nectar utilised by bees to make honey.

Honeydew

Honey dew is a sugar rich sticky liquid secreted by aphids and some scale insects as they feed on plant sapp.Honey dew is particularly common as a secretion in hemipteran insects and is often the basis of tropohobiosis. The sap is ingested and is passed through the insects gut, and the surplus is excreted as droplets of honeydew, which are gathered by the bees. There are different types of honeydew secreting insects. Most plants are trees, the conferous trees yield the highest amount of honeydew. However, there are also other plants e.g cotton, Luceme and sunflower which can provide honeydew. Honey dew contains sugars, amino acids and minerals and acts as a substrate for the growth of soothy mould. It is a solution and vary in sugar concentration (5-60%) contains mainly, sucrose besides higher sugars (oligosaccharides).Amino acids, sugars proteins, minerals and vitamins are present in smaller amounts or traces.

Table 1: Requirements for extracted honey as per Indian Standard (Clause 5.5 IS 4941)

S.No	Characteristics	Special grade	A-Grade	Standard grade
1	Specific gravity at 27 ^{0}C min	1.37	1.37	1.37
2	Moisture (By mass max.)	20	22	25
3	Total reducing sugar (by mass)	70	65	65
4	Sucrose (mass)	5.0	5.0	5.0
5	Fructose-Glucose ratio (min)	1.0	1.0	1.0
6	Ash% (by mass)	0.5	0.5	0.5
7	Acidity %	0.2	0.2	0.2
8	Fiehe's test	Negative	Negative	Negative
9	HMF (mg/kg)	80	80	80
10	Total count of pollens /gm of honey	50,000	50,000	50,000
11	Optical density at 660nm	0.3	0.3	0.3

Composition

Table 1 shows the general makeup of honey. Carbohydrates make up the majority of the honey's dry weight, accounting for around 95%. Honey contains a variety of substances, including organic acids, proteins, amino acids, minerals, polyphenols, vitamins, and fragrance compounds, in addition to carbs. In conclusion, the contribution of honey to the necessary daily intake is negligible, based on the data in Table 1. However, its significance in terms of nutrition is due to the numerous physiological impacts. It's worth noting that the composition of honey is highly dependent on the botanical origin, a feature that's rarely taken into account in nutritional and physiological research.

Carbohydrates

The monosaccharides fructose and glucose are the most common sugars. A total of 25 distinct oligosacharides have also been discovered. The disaccharides sucrose, maltose, trehalose, and turanose, as well as certain nutritionally important ones like panose, 1-kestose, 6-kestose, and palatinose, are the main oligosaccharides in blossom honey. Honeydew honey includes more of the oligosaccharides melezitose and raffinose than blossom honey. Following honey consumption, the main carbohydrates fructose and glucose are immediately delivered into the bloodstream and can be used by the human body for energy needs. A daily dosage of 20 g honey will provide roughly 3% of the daily energy requirements.

Proteins, enzymes and amino acids

Honey has a protein content of about 0.5 percent, mostly enzymes and free amino acids. That proportion makes a minor contribution to human protein consumption. Diastase (amylase), which decomposes starch or glycogen into smaller sugar units, invertase (sucrase, -glucosidase), which decomposes sucrose into fructose and glucose, and glucose oxidase, which produces hydrogen peroxide and gluconic acid from glucose, are the three main honey enzymes.

Vitamins, minerals and trace compounds

Honey contains a modest amount of vitamins and minerals, and its contribution to the recommended daily intake (RDI) of certain trace components is negligible. Different unifloral honeys are reported to have varied levels of minerals and trace elements. In terms of nutrition, chromium, manganese, and selenium are essential, especially for youngsters aged 1 to 15. Sulphur, boron, cobalt, fluoride, iodide, molybdenum, and silicon are also significant in human nutrition, albeit no RDI values have been given for them. Honey has a choline content of 0.3-25 mg/kg and an acetylcholine content of 0.06 to 5 mg/kg. Choline is required for cardiovascular and brain function, as well as the composition and repair of cellular membranes, and acetylcholine is a neurotransmitter.

Aroma compounds, taste-building compounds and polyphenols

Honey comes in a wide range of flavours and colours, depending on the botanical origin. The principal taste-building elements are sugars. Honey with a high fructose content (such as acacia) is often sweeter than honey with a high glucose content (e.g. rape). Honey's scent is also influenced by the amount and kind of acids and amino acids present. Over the last few decades, substantial study on fragrance compounds has been conducted, with over 500 distinct volatile substances discovered in various types of honey. Indeed, depending on the botanical origin of honey, the majority of aroma-building elements change. Honey flavour is a significant attribute for its application in the food sector as well as a consumer selection factor. In terms of the look and functional qualities of honey, polyphenols are another important group of compounds. Different honey kinds contained 56 to 500 mg/kg total polyphenols. Flavonoids (e.g., quercetin, luteolin, kaempferol, apigenin, chrysin, galangin), phenolic acids, and phenolic acid derivatives make up the majority of polyphenols in honey. Antioxidant properties are known to exist in these substances. The flavonoids are the most common polyphenols, with levels ranging from 60 to 460 g/100 g of honey and being higher in samples generated during a dry season with high temperatures.

Contaminants and toxic compounds

Honey, like any other natural food, can be contaminated by the environment, such as heavy metals, pesticides, antibiotics, and other contaminants. In general, the levels of pollution seen in Europe do not pose a health risk. The contamination of antibiotics used to treat bee brood infections has been a major issue in previous years, but it appears to be under control now. Antibiotics are not allowed for that purpose in the European Union, hence honey containing antibiotics is likewise not allowed on the market. . There are a few plants that bees use to generate nectar that contains toxic substances. The main toxin categories found in nectar are diterpenoids and pyrrazolidine alkaloids. Some Ericaceae species in the Rhododendron subfamily, such as Rhododendron ponticum, contain poisonous polyhydroxylated cyclic hydrocarbons or diterpenoids. The chemicals of the other toxin category, the pyrrazolidine alkaloids, found in various honey kinds are discussed, as well as their potential poisoning. Honey poisoning has been recorded in the literature seldom and has affected people from the Caucasus, Turkey, New Zealand, Australia, Japan, Nepal, South Africa, and certain North and South American countries. Vomiting, headaches, stomachaches, unconsciousness, delirium, nausea, and vision loss are some of the symptoms of honey poisoning. In general, local beekeepers are aware of toxic plants, and honey containing toxic compounds is not sold. In areas where plants with deadly nectar thrive, travellers are encouraged to buy honey in shops rather than on the road or from individual beekeepers to reduce the danger of honey-borne poisoning.

	Blossom honey		Honeydew honey	
	average	min. - max.	average	min. - max.
Water	17.2	15-20	16.3	15-20
Monosaccharides				
fructose	38.2	30-45	31.8	28-40
glucose	31.3	24-40	26.1	19-32
Disaccharides				
sucrose	0.7	0.1-4.8	0.5	0.1-4.7
others	5.0	2-8	4.0	1-6
Trisaccharides				
melezitose	<0.1		4.0	0.3-22.0
erlose	0.8	0.5-6	1.0	0.1-6
others	0.5	0.5-1	3.0	0.1-6
Undetermined oligosaccharides	3.1		10.1	
Total sugars	**79.7**		**80.5**	
Minerals	0.2	0.1-0.5	0.9	0.6-2.0
Amino acids, proteins	0.3	0.2-0.4	0.6	0.4-0.7
Acids	0.5	0.2-0.8	1.1	0.8-1.5
pH-value	3.9	3.5-4.5	5.2	4.5-6.5

Glycemic index and fructose

The impact of carbs on human health is debatable, especially when it comes to understanding how carbohydrates in a certain food affect blood glucose levels. Currently, the glycemic index is used to describe the dietary relevance of carbohydrates (GI). Carbohydrates with a low GI induce a little increase in blood glucose, whereas those with a high GI cause a significant increase in blood glucose. Due to the various fructose/glucose ratios of the honey varieties studied, a strong negative connection between fructose content and GI is seen. Unifloral honeys have varied fructose levels and fructose/glucose ratios, according to research. Some honeys, such as acacia and yellow box, have a lower GI than others because of their high fructose content. The GI sugar has no discernible link with the other honey sugars. The GI values of four honeys ranged from 69 to 74 in one study, while the value of an unclear honey's botanical origin was found to be 35 in another. Honeys with a low GI can be a good option for high GI sweeteners, as the notion of GI states can anticipate the involvement of carbs in the development of obesity. . Glycemic load is a novel term that was coined to account for the quantity of food consumed. It's commonly computed by multiplying the GI value by the carbohydrate content of a certain meal and then dividing by 100. Low numbers are referred to as low, intermediate values are referred to as intermediate, and values exceeding 20 are referred to as high. The glycemic load of most honey kinds is low, while some varieties are in the intermediate range, according to a 25 g honey portion. The GI system was created to provide a numerical classification of carbohydrate-containing foods, with the belief that such information is useful in cases where glucose tolerance is impaired. . As a result, meals with a low GI should help diabetics while also lowering the risk of coronary heart disease. Consumption of low-GI honeys, such as acacia honey, may have beneficial physiological benefits and could be beneficial to diabetics. When healthy people and diabetes patients consume 50 g of unidentified type honey, their blood insulin and glucose levels are lower than when they consume the same amounts of glucose or a sugar mixture comparable to honey. Honey consumption has a beneficial effect on diabetic patients, as it lowers plasma glucose levels significantly. Honey was found to be well tolerated by individuals with diabetes of unknown type as well as people with diabetes type 2. Long-term consumption of high-GI foods has been shown to be a substantial risk factor for type-2 diabetes patients in recent research. The concept of GI for the general public, on the other hand, is still being debated. Fructose is the most common sugar found in honey. Excess fructose consumption in today's American diet, primarily in the form of high-fructose corn syrup, is thought to be one of the main causes of obesity. These researchers discovered that consuming fructose induces an increase in de-novo lipogenesis, which has an unfavourable effect on energy regulation and body weight. In rat feeding trials, the hypertriglyceridemic effect shown after fructose consumption is not seen after honey consumption. When compared to honey-fed rats, fructose-fed rats have greater plasma -tocopherol levels, higher -tocopherol/triacylglycerol ratios, lower plasma NOx levels, and a lower vulnerability of the heart to lipid peroxidation. These findings suggest that replacing fructose in the diet with honey may have nutritional benefits. Honey (2 g/kg body weight) and fructose consumption can protect erythrocytes from ethanol-induced transformation in mice.

Honey delivery resulted in a faster recovery from ethanol intoxication in people, as well as a proven high rate of ethanol elimination.

DIFFERENT PHYSIOLOGICAL EFFECTS

Honey has anti-bacterial, antiviral, and anti-parasitic properties. It stops microorganisms and fungus from growing. It has been proven to have antibacterial properties, primarily against gram-positive bacteria. Honey has been shown to have bacteriostatic and bactericidal effects on a variety of bacteria, many of which are harmful. Honey has also been proven to prevent the growth of Rubella virus, three types of Leishmania parasite, and Echinococcus in vitro. Its antibacterial activity is related to a variety of elements and is dependent on the honey's botanical source. Honey has a low water activity and prevents the growth of microorganisms. Honey glucose oxidase produces hydrogen peroxide, an antibacterial agent, although peroxide capacity is also dependent on honey catalase activity. Other non-peroxide antibacterial compounds with various chemical origins, such as aromatic acids, unknown molecules with various chemical characteristics, phenolics, and flavonoids, are also present. Antibacterial action can also be attributed to honey with a low pH. Unlike non-peroxide activity, peroxide activity can be destroyed by heat, light, and storage. The antibacterial activity of blossom honey was higher than that of honeydew honey due to these many variables. Honey should be kept in a cool, dark place and consumed as soon as possible for maximum antibacterial activity.

Antioxidant effects

The word "oxidative stress" refers to a loss of balance between the creation of free radicals and the antioxidants' protective activity in a specific organism. Protection against oxidation can help prevent several chronic diseases. The oxidative alteration of lipoproteins is thought to play a role in the aetiology of arteriosclerosis. Honey is thought to have the highest antioxidant activity, which includes glucose oxidase, catalase, ascorbic acid, flavonoids, phenolic acids, carotenoid derivatives, organic acids, Maillard reaction products, amino acids, and proteins, among others. Honey polyphenols' antioxidative activity can be determined in vitro by comparing the oxygen radical absorbance capacity (ORAC) to the total phenolics concentration. A substantial link was discovered between honey's antioxidant activity, phenolic content, and in vitro lipoprotein oxidation in human serum. Furthermore, buckwheat honey showed antioxidant efficacy comparable to 1mM-tocopherol in a lipid peroxidation model inhibitory system. Two investigations looked at the influence of honey consumption on plasma antioxidative capacity. In the first study, participants were given 1.5 g/kg body weight of maize syrup or buckwheat honeys, each having a different antioxidant capacity. Honey, in contrast to the sugar control, increased both antioxidant and lowering serum capacity. In the second research, participants ate a diet supplemented with 1.2 g/kg body weight of honey on a regular basis. Honey was shown to have a concentration of 47 percent blood vitamin C, 3 percent β-carotene, 12 percent uric acid, and 7 percent glutathione reductase, all of which were thought to boost the body's antioxidant agents. It's important to remember that honey's antioxidant activity is highly dependent on the botanical source of the honey, and it varies greatly amongst honeys from different botanical sources. The antioxidant capacity of clover and buckwheat honey was recently studied in relation to heat and storage period. While there was no effect of processing on the antioxidant capacity of clover honey, there was a 30% decline in antioxidant activity after 6 months of storage. After a period of storage, the antioxidant capacity of processed and raw honeys was found to be similar. In another study, thermal treatment and storage increased antioxidant activity as well as the synthesis of brown pigments.

Antimutagenic and antitumor activity

Mutagenic compounds cause mutations in the genetic structure, either directly or indirectly. Heterocyclic amines, such as Trp-p-1, are generated during the roasting and frying of food (3-Amino-1,4-dimethyl-5H-pyridol [4,3-b] indole). The Ames assay was used to investigate the antimutagenic activity of honeys from seven distinct floral sources (acacia, buckwheat, fireweed, soybean, tupelo, and Christmas berry) against Trp-p-1, and the results were compared to a sugar analogue and individually tested simple sugars. Trp-p-1 mutagenicity was significantly inhibited by all honeys. Honey-like antimutagenic action was discovered in glucose and fructose. Another sugar found in honey, nigerose, has immunoprotective properties. Honey was used to investigate the anti-metastatic impact of honey and its putative route of anti-tumor action in spontaneous breast cancer, methylcholanthrene-induced fibrosarcoma in CBA mice, and anaplastic colon adenocarcinoma in Y59 rats. Honey was found to have a statistically significant anti-metastatic effect when taken orally. These findings suggest that honey stimulates the immune system, and that honey consumption may be beneficial in the prevention of cancer and metastasis. Furthermore, honey taken orally prior to tumour cell inoculation is thought to have a reduced influence on tumour progression. Honey's influence on tumour growth, metastasis, and activation of apoptosis and necrosis in mouse tumour models (mammary and colon cancer) was explored in another study by the same group. When honey was administered before tumor-cell inoculation (per oral 2 g kg-1 for mice or 1 g kg-1 for rats, once a day for 10 days), it had a strong antimetastatic effect. Honey's anti-tumour efficacy against bladder cancer was investigated in vitro and in vivo in mice in another study. Honey is an efficient inhibitor of the proliferation of several bladder cancer cell lines (T24, RT4, 253J, and MBT-2) in vitro, according to these findings. In the MBT-2 bladder cancer implantation mice models, it is also efficacious when given intralesionally or orally.

Anti-inflammatory effects

Al Waili and Boni investigated the anti-inflammatory benefits of honey in humans after consuming 70 g of honey. At 1, 2, and 3 hours after honey eating, the mean plasma concentration of thromboxane B(2) was lowered by 7%, 34%, and 35%, respectively, while the mean plasma concentration of PGE(2) was reduced by 14%, 10%, and 19%. After eating of honey, the level of PGF(2) was reduced by 31% after 2 hours and by 14% after 3 hours. Plasma concentrations of thromboxane B(2), PGE(2), and PGF(2) dropped by 48%, 63%, and 50%, respectively, on day 15. Honey consumption reduced inflammation in rats in an experimental model of inflammatory bowel disease. In an inflammatory model of colitis, honey is as beneficial as prednisolone therapy. The suggested mechanism of action is by inhibiting the generation of free radicals released by the inflamed tissues. Honey's antimicrobial impact or a direct anti-inflammatory effect could be responsible for the reduction in inflammation. Honey's ant-iinflammatory properties in wounds without bacterial infection were shown in animal tests, supporting the latter explanation.

Various physiological effects

Honey was tested on the generation of antibodies against thymus-dependent antigen in sheep red blood cells and thymus-independent antigen (Escherichia coli) in mice. Antibody generation during primary and secondary immunological responses to thymus-dependent and thymusindependent antigens is stimulated by oral honey consumption. Honey has been shown to have immunosuppressive properties in animal studies. This could explain why it's been suggested that honey can help people with pollen hypersensitivity. In one trial, people were given a diet supplemented with 1.2 gm of honey per kg of body weight on a regular basis. The effects noticed in blood serum were an increase of monocytes (50 %), copper (33%), iron (20%), a slight increase of lymphocyte and eosinophil percentages, magnesium, zinc, hemoglobin and packed cell volume and a reduction of: ferritin (11%), aspartate transaminase (22%), immunoglobulin E (34%), lactic acid dehydrogenase (41%), alanine transaminase (18%), creatine kinase (33%) and fasting sugar (5%).

NUTRITION AND HEALTH EFFECTS

Oral health

There's a lot of disagreement over whether honey is bad for your teeth. According to some findings, honey has a cariogenic impact or has a significantly lower cariogenic effect than sucrose. Honey consumption prevents the growth of germs that cause cavities and may have a carioprotective effect due to its antibacterial properties. Manuka honey, a highly effective antimicrobial honey, has been found to have a good effect on the development of dental plaque and gingivitis, and can be used instead of refined sugar in the production of candies. Honey consumption does not induce dental enamel degradation like that seen after drinking fruit juice, according to electron microscope studies. Tooth erosion was noticed ten minutes after drinking fruit juice, whereas only very weak tooth erosion was observed 30 minutes after consuming honey. The calcium, phosphorous, and fluoride levels in honey can only explain a portion of this action, and other colloidal honey components may also play a role. In light of the various data, it may be inferred that honey is likely not as cariogenic as other sugars, and that it can even be carioprotective in some situations. To be safe, however, it is recommended to brush teeth after eating honey.

Gastroenterology

Prophet Mohamed (p.b.u.h) recommended honey to treat diarrhoea, according to the Muslim holy book "The Holy Hadith," which dates from the 8th century AD. Honey was also employed as a diarrhoea remedy by the Roman physician Celsus (about 25 AD). Honey has been documented in numerous books and publications from Eastern Europe and Arab countries for the prevention and treatment of gastro-intestinal illnesses such as peptic ulcers, gastritis, and gastroenteritis. Honey is a powerful inhibitor of Helicobacter pylori, the bacteria that causes peptic ulcers and gastritis. Honey protected rats against experimentally generated stomach ulcers caused by indomethacin and alcohol. Honey does not contribute to the synthesis of prostaglandins, but it does stimulate the sensory nerves in the stomach that respond to capsaicin.

A second mechanism of action has been hypothesised, claiming that honey's antioxidant qualities are responsible for the impact. Honey consumption reduced the ulcer index, microvascular permeability, and myeloperoxidase activity of the stomach in rats, preventing indomethacin-induced gastric ulcers. Honey was also found to preserve the level of non-protein sulfhydryl molecules (e.g. glutathione) in gastric tissue that had been exposed to ulcer-causing stimuli. The acidity of stomach juice was lowered by 56 % when dandelion honey was consumed. After eating honey, the stomach emptying of saccharides was slower than after eating a mixture of glucose and fructose. Oligosaccharides have also been related to other major effects of honey on human digestion. Prebiotic effects are similar to fructo-oligosaccharides in these honey components. Panose, the most active oligosaccharide, was the most active oligosaccharide. The oligosaccharides stimulate the growth of bifidobacteria and lactobacilli, resulting in a synergistic prebiotic effect. Honey has a growth-promoting impact similar to fructose and glucose oligosaccharides, according to an in vitro investigation on five bifidobacteria strains. Five human intestinal bifidobacteria were activated by unifloral honeys of sour-wood, alfalfa, and sage origin. Honey boosted the growth of Lactobacillus acidophilus and Lactobacillus plantarum both in vivo (small and large intestines of rats) and in vitro, but sucrose had no impact. Honey reduces the duration of bacterial diarrhoea in infants and children, but does not extend the duration of non-bacterial diarrhoea. Individuals with poor honey fructose absorption may experience a moderate laxative effect after consuming relatively large amounts of honey (50 to 100 g). In the digestive tract, fructose alone is less quickly absorbed than fructose combined with glucose. Honey is used to relieve constipation in Eastern Europe because of its mild laxative qualities. Honey supplementation at doses of 2, 4, 6, and 8 g/100 g protein increased protein and fat digestibility in rats.

Cardiovascular health

In humans, the impacts of 75 g of natural honey vs. the same amount of artificial honey (fructose plus glucose) or glucose on plasma glucose, insulin, cholesterol, triglycerides (TG), blood lipids, C-reactive proteins, and homocysteine, all of which are risk factors for cardiovascular disease, were investigated. After glucose consumption, insulin and C-reactive protein levels were considerably greater than after honey consumption. Glucose decreased cholesterol and LDL-cholesterol levels (LDL-C). Artificial honey reduced cholesterol and LDL-C but increased TG.

Honey lowers cholesterol, LDL-C, and TG levels while modestly raising HDL-cholesterol levels (HDL-C) Artificial honey raised TG in hypertriglyceridemia patients, whereas honey lowered TG. Artificial honey raised LDL-C in hyperlipidemic patients, whereas honey lowered LDL-C. Honey caused a much smaller rise in plasma glucose in diabetic subjects when compared to dextrose. Honey may include metabolites of nitric oxide (NO), which are known risk factors for cardiovascular disease. Increased nitric oxide levels in honey may have a protective effect against cardiovascular disease. After ingestion of 80 g of honey, total nitrite concentrations in various biological fluids from individuals, including saliva, plasma, and urine, were examined. The concentrations of NO metabolites in saliva, plasma, and urine all increased. NO metabolites were found in different amounts in different honey varieties, with darker or fresh honeys carrying more NO metabolites than light or preserved honey. NO metabolites in all honey kinds decreased after heating. Honey-fed rats showed greater plasma -tocopherol levels and a higher -tocopherol/triacylglycerol ratio than fructose-fed rats, as well as lower plasma nitrate levels and lower susceptibility to lipid peroxidation in the heart.

Infants

Using honey in newborn nourishment was formerly a popular advice, and there are some fascinating findings. Infants on a honey-based diet had better blood formation and gained more weight than those on a honey-free diet. Honey was found to be better accepted by babies than sucrose, and it dramatically reduced the crying periods of infants when compared to a water-based placebo. Honey-fed infants gained more weight than sucrose-fed infants and threw up less than sucrose-fed controls. There was an increase in haemoglobin content, a better skin colour, and no digestion difficulties when newborns were fed honey instead of sugar. Honey-fed newborns were less susceptible to diseases than those who were fed normally or given blood-building products.Honey's beneficial effects in newborn feeding are linked to its influence on the digestive process. The well-known action of oligosaccharides on B. bifidus is one possible reason. When fed a honey and milk mixture, newborns gained weight steadily and had an acidophilic microbial flora high in B. bifidus. Another study found that infants who ate honey and milk had less diarrhoea and had more haemoglobin in their blood than those who ate sucrose sweetened milk. Honey-fed babies showed better calcium absorption and lighter, thinner faeces. The presence of Clostridium (Cl.) botulinum in honey, however, poses a health risk to newborns. Because this bacterium is commonly found in natural foods, and honey is a non-sterilized packaged item of natural origin, the possibility of a low contamination level cannot be ruled out. This bacterium's spores can survive in honey, but they can't produce poison. Thus, bacteria spores from honey can live in the stomachs of infants younger than one year and theoretically develop the toxin, whereas children older than 12 months can eat honey without concern. Ingestion of honey has been linked to baby botulism in some circumstances. Each year, one instance of newborn botulism is documented in Germany b ecause of the documented newborn botulism cases, several honey packers (such as the British Honey Importers and Packers Association) have placed a warning on the honey label that "honey should not be given to infants under the age of 12 months." A European Union scientific committee recently looked into the dangers of Cl. botulinum in honey because the prevalence of Cl. botulinum is generally low and sporadic, microbiological investigations of honey are required for managing the spore concentration in honey as a result, tests will not prevent newborn botulism. In the EU, there is no rule requiring a warning label to be placed on honey jars.

Athletic performance

Kreider and coworkers recently investigated the physiological action of honey gel and powdered forms as a carbohydrate source for athlete performance under controlled conditions. During the performance, honey elevated the heart rate and blood glucose level considerably. In fasted athletes or during resistance exercise, it did not cause physical or psychological indicators of hypoglycemia. Another study looked at the effects of low and high GI carbohydrate gels, as well as honey, on a 64-kilometer cycling performance. High GI (glucose) and low GI (honey) gels both improved cycling performance, however honey's effect was slightly better than glucose's. According to the research mentioned above, honey is well tolerated and can be a good carbohydrate supply for athletes.

Different health enhancing effects

Honey had a favourable effect on hepatitis A patients, inducing a decrease in alanine aminotransferase activity (by 9 to 13 times) and a decrease in bilirubin production (by 2.1 to 2.6 times) after ingestion of clover and rape honey. Honey reduces the incidence of radiation mucositis in cancer patients who had radiation therapy. Honey was administered to patients with head and neck cancer who were undergoing radiation therapy. When honey-treated patients were compared to controls, there was a considerable reduction in symptomatic grade 3/4 mucositis:

20% versus 75%. Patients in the honey-treated group were more compliant than those in the control group. When compared to the controls, 55 percent of the honey-treated patients showed no change or a positive gain in body weight, while the majority of the controls lost weight. Honey was found to lessen the demand for colony-stimulating agents in chemotherapy patients who had neutropenia. Chemotherapy can cause febrile neutropenia, which is a significant adverse effect.

Allergy

Honey allergies appear to be rather uncommon; symptoms described range from cough to anaphylaxis. Patients allergic to pollen are rarely allergic to honey, according to this study, yet one case of combined honey pollen allergy has been described. Honey allergy was shown to be present in 2.3 percent of 173 food allergy patients. Honey allergy is explained in this study by the presence of bee-derived components.

Prebiotic properties

It's unclear whether all varieties of honey have prebiotic benefits, or if some honeys have a larger prebiotic effect than others. Honeys from sour wood, alfalfa, sage, and clover have been proven to have prebiotic properties. It was discovered that chestnut honey had a higher prebiotic activity than acacia honey. Honeydew honey oligosaccharides have prebiotic properties. Honeydew honeys, which contain more oligosaccharides, should theoretically have a higher prebiotic activity than blossom honeys. More investigation into the prebiotic activity of unifloral honeys is required.

HONEY AGAINST COUGH

Honey in little quantities, 1 to 2 tablespoons, has been reported to improve cough and sleep in youngsters. Honey doses were 12 teaspoons for children aged 2 to 5, 1 teaspoon for children aged 6 to 11, and 2 teaspoons for children aged 12 to 18. Because of its excellent antioxidant characteristics, buckwheat honey was chosen for this investigation. Honey is more effective than a pharmaceutical anti-cough medication, according to the same study.

HONEY IMPROVES SLEEP

Honey has long been said to have a favourable effect on human sleep, but there have been no studies to back up the assertions. Coughing children's sleep was improved by consuming one to two table spoons of buckwheat honey (10-20 g) by children aged 6 to 18 years (6-11 years old- one table spoon, 12-18 years old- two table spoons). Honey stabilises blood sugar levels and contributes to the production of melatonin, the hormone essential for bodily tissue regeneration and rebuilding during rest, according to a theoretical model explaining honey's effect on sleep.

OTHER HEALTH ENHANCING EFFECTS

Hay fever

Honey could also be used to prevent hay fever, which is a contentious topic. Beekeepers suggest that eating honey in the pre-vegetation season (i.e. during winter) may eliminate or reduce hay fever symptoms. Croft reported data that daily consumption of 10-20 g of honey throughout the winter months alleviated hay fever symptoms in 16 out of 21 patients. Using a questionnaire filled out by 29 beekeepers, Münstedt and Kalder discovered that honey consumption has a favourable effect. A 2002 clinical experiment found no evidence of honey's beneficial effects, however honey was consumed during the hay fever season, not before. As the prevalence of hay fever rises in industrialised countries, more clinical studies should be conducted in a proper manner. More research is needed to confirm this probable honey impact.

Infertility

Intracervical injection of honey in women with chronic endocervitis was of positive therapeutic benefit both in terms of clinical treatment and fertility improvement, according to a preliminary announcement made at the 2nd International Conference on the Medicinal Use of Honey in 2010. Honey was found to have a favourable effect on the mechanical characteristics of embryonic membranes at the same meeting, possibly due to its "collagen stimulating function."

Against alcohol abuse

Honey's beneficial benefits on ethanol intoxication, such as increased blood disappearance and ethanol clearance rate, have been demonstrated in human investigations. Honey (2 g/kg body weight) and fructose consumption inhibited the ethanol-induced alteration of mouse erythrocytes.

Hepatitis

Honey had a favourable effect on hepatitis A patients, producing a decrease in alanine aminotransferase activity (by 9 to 13 times) and bilirubin production (by 2.1 to 2.6 times) after ingestion of clover and rape honey15.

Anaemia

Remy Chauvin discusses many early investigations carried out on 4-8 year old infants by Theobald and Frauenfelder and Errerich in Germany, Perez in Spain, and Johnsen in Sweden. One tea to one soup spoon in warm milk was given once a day. After one week of consumption, blood haemoglobin levels increased. Experiments by Haydak et al. with rats on a milk-based diet deficient in iron corroborate these clinical findings. Only dark honeys, such as calluna, were able to restore normal blood haemoglobin levels, but light honeys failed.

Influenza and common cold

According to an Iranian study, consuming 50 gm of honey everyday cuts the duration of the common cold by two days.

HONEY FOR DIFFERENT EXTERNAL APPLICATIONS

Honey has a variety of exterior uses in addition to treating wounds and burns:

Against virus action on lips and genitals :

Apply honey to a key area on gauze and replace it once a day.

Against boils and furuncles

Combine liquid honey and flour in a 1:1 ratio, add a little water, and apply to the affected region with a brush. Leave it overnight covered with gauze

Against muscle cramps

Apply honey to the injured region, wrap it with gauze or cloth, and secure it with adhesive plaster. Cover with a warm wool cloth if possible. Allow at least two hours.

Against bruises and contusions

Merge honey and olive oil in a 1:1 ratio and apply to the affected region. Leave for 4-6 hours after covering with gauze

Honey massage

Honey massage originated in Tibet and Russia, and has since been widely documented. Honeys can be utilised in both liquid and crystalline form.

Honey in Cosmetics

Honey has been utilised in cosmetics since ancient times. For her beauty, Queen Cleopatra bathed in honey and milk. Honey is now included in a wide range of cosmetics. Honey cosmetics are generally suited for all skin types. Honey is hygroscopic, antibacterial, and antifungal, with skin-nourishing properties. It's moderately acetic and helps to strengthen the upper acetic protective layer of the skin (pH of the skin is 5.5).

Physical properties

The numerous parts of honey technology, such as harvest, storage, granulation, and liquefaction, require knowledge of the physical features of honey.

Water content and water activity

Water is the second most important constituent of honey in terms of quantity. The aw value, or water activity, is a unit proportional to the amount of free water in food. Microbiologically stable aw values are less than 0.60. Actually, the water content is a higher quality criterion for honey. The water content and activity of various honeys have been reported to be between 10.6-29.0 g/100g and 0.483-0.70, respectively.

Hygroscopicity

Honey has a high hygroscopicity. At a relative humidity of over 60%, normal honey with a water content of 18.3 percent or less will absorb moisture from the air. When the partial vapour pressure of surface water equals the partial vapour pressure of the environment, equilibrium moisture content (EMC) is obtained. The substance does not absorb or release moisture in this state.

Viscosity

1 *Gallic Acid Equivalents*

2 *Quercetin Equivalents*

3 Electrical conductivity

According to many experts, honey was once thought to be a Newtonian fluid. Honey tends to behave like a Newtonian fluid at high shear rates. According to some reports, honey is a non-Newtonian fluid at the shear rate examined.

Thermal properties (Glass transition temperature (*Tg*))

The glass transition temperature of food systems is heavily influenced by carbohydrate contents. In a food system, water acts as a strong plasticizer, lowering the Tg considerably due to its low

Tg of -135 oC. Tg expertise is critical for ensuring the quality, stability, and safety of a variety of food products. Tg values for certain honeys range from (-127.19) to (-127.19). (-30.50).

Honey color

Liquid honey can be clear and colourless (like water) or dark amber or black in hue. Darker honeys are more commonly used in industry, whilst lighter honeys are sold directly to consumers. Some honeys have L*, a*, b*, and ABS (mAU) values of 18.95-101, (-5.06)-27.83, (-10.3)-68.54, and 0.113-1678, respectively.

HONEY ADULTERATION

According to the Codex Alimentarius and other international honey standards, honey must not contain any more food ingredients than honey, nor should any constituent be eliminated. Adulteration detection is a technical challenge. Honey is tainted with low-cost sweeteners such corn syrups (CS), high-fructose corn syrups (HFCS), invert syrups (IS), and high-fructose inulin syrups (HFIS) (HFIS).Because its contents are the principal natural components of honey, and the adulterated product would have identical physical attributes to natural honey, the adulteration of honey with invert sugar or syrup may not be easily detected by direct sugar analysis. Researchers and regulatory agencies are still looking for newer, easier, more sensitive, and cost-effective processes.

Analysis methods

Gas Chromatography (GC) and Liquid Chromatography (LC) analysis

Sugars in honey were analysed using both GC and LC at the same time. Exogenous sugar additions could be detected as acceptable adulteration signatures. This method could be used in place of isotopic analysis, which has significant drawbacks. In another study, a GC–MS technique for detecting honey adulteration with high fructose inulin syrups (HFIS) was created.

Near Infrared Transflectance Spectroscopy (NIR)

Near-infrared spectroscopy is a good approach for determining whether honey samples are adulterated in real time. It is a quick, non-destructive, and generally low-cost procedure that could be used as a screening technique for honey quality control. It has the ability to detect adulteration by beet invert or high fructose corn syrups at low quantities, which could be commercially beneficial.

Fourier Transform Infrared (FTIR) spectroscopy with Attenuated Total Reflectance (ATR)

FTIR in combination with multivariate statistical approaches (chemometrics) allows for the direct, reliable, and rapid acquisition of particular information about several parameters at the same time. These FTIR spectroscopy procedures, in contrast to the time-consuming carbon isotope ratio analysis approaches, can be completed in a very short amount of time. It has been feasible to successfully quantify the concentration of adulterants such as corn syrup, HFCS, and inverted sugar in honeys using ATR mid infrared Fourier transform spectroscopy.

Protein characterization

SDS–PAGE with silver staining revealed at least nineteen protein bands in honeys from various plant sources. SDS–PAGE was used to differentiate pollen from different plants, and pollen proteins can be employed as chemical markers for honey floral categorization, according to the researchers. Differences in the molecular weight of several key proteins in honey were discovered, in addition to variances in the geographical and floral origins of honey. Overall, the molecular weights of the key proteins in honey vary depending on the honeybee species. As a result, measuring key proteins in honey is a good tool for distinguishing between honey produced by various honeybee species.

High-Performance Anion-Exchange Chromatography with Pulsed Amperometric Detection (HPAEC-PAD)

In laboratories, a simple and easy method based on activated charcoal treatment to fractionate honey carbohydrates followed by HPAEC-PAD analysis of the oligosaccharide fraction has been developed to identify adulterations of corn syrups (CS), high fructose corn syrups (HFCS), and bee-feeding adulterations in genuine honey samples. It's also a useful tool for identifying different honey floral species. This procedure takes less time and costs less money than previous ways.

Liquid Chromatography Coupled to Isotope Ratio Mass Spectrometry (HPLC-IRMS)

To improve isotopic methodologies devoted to the research of honey authenticity, a new procedure using liquid chromatography-isotope ratio mass spectrometry (HPLC-IRMS) has been devised to measure each sugar (sucrose, glucose, and fructose) 13C isotope ratios. In terms of analysis speed, sensitivity, sample preparation time, reagent consumption, and operative procedure simplicity, the new process outperforms previous methods. Furthermore, it is the first isotopic approach for detecting beet sugar addition that has been devised.

Calorimetric methods (Application of DSC)

The use of DSC to characterise the thermal behaviour of honeys and detect the effect of adulteration on physicochemical and structural features of samples demonstrated the feasibility of using the glass transition temperature to discriminate between honeys and syrups.

Stable Carbon Isotope Ratio Analysis (SCIRA)

For many years, the SCIRA has been a common analysis approach for detecting honey adulteration. It's determined by the 13C/12C isotope ratio, which differs in C4 or CAM plants (such as cane and maize sugar) from C3 plants (most flowering plants from which bees collect nectar). It's worth noting that the isotope ratioing technique is only good for detecting honey-adulterated C4 plant sugars, not C3 sugars.A laboratory can identify if the honey was adulterated and estimate the percentage of adulteration by comparing the carbon isotope ratios in the protein and sugars of honey, which should be the same if they came from the same source. **Fourier Transform (FT) Raman spectroscopy**

Beet and cane invert syrups have been successfully detected using FT-Raman spectroscopy. This approach can also be used to distinguish between different forms of adulterants, regardless of their botanical source.

Microscopic detection

Microscopic examination of cane sugar-adulterated honey revealed parenchyma cells, single ring capillaries, and epidermal cells. Overall, the microscopic process is an effective screening tool for detecting honey adulteration with sugar cane products.

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