

## Anti-obesity Effects of Corn Silk: A Scoping Review on its Mechanism of Action and Future Possibilities

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### Abstract

In the present-day, obesity is one of the major public health issues negatively impacting life expectancy. Anti-obesity treatment involves drug therapy, which also has complications and side effects when used for the long term hence, the demand for plant-based treatments in terms of food and drugs is increasing. Corn silk also known as *Stigma maydis* is a type of agricultural waste composed of a long, silky, hair-like structure ranging from yellowish to reddish in colour. It covers the edible portions of corn and is known to possess pharmacological properties including antioxidant, anti-diabetic, anti-fatigue, and anti-inflammatory effects. Traditionally, corn silk has been used to treat numerous types of illnesses. The current study is based on the anti-obesity effect of corn silk and its bioactive compounds, namely flavonoids, phenolic acid, flavones, volatile pigments, polyphenols, sterols, etc. *In vitro* and *in vivo* studies of corn silk showed adipogenesis, lipid metabolism and body weight management. Corn silk extracts can reduce body weight, suppress appetite, regulate lipid metabolism, and improve insulin sensitivity. Additionally, it reduces and inhibits adipose tissue formation and reduces the size of adipocytes and prevents excess fat accumulation. The anti-obesity effect of maize silk extract decreases the absorption of dietary fat and suppresses the formation of fatty acids. Corn silk inhibits the expression of adipogenic transcription factors like the peroxisome proliferator-activated receptor gamma and CCAAT/enhancer-binding proteins (C/EBPs) and prevents the differentiation of pre-mature adipocytes into mature adipocytes, it also suppresses the development of adipose tissue and the accumulation of excess fat. Corn silk suppresses the appetite by influencing the appetite-regulating hormone. In the current review, the anti-obesity effect and mechanism of corn silk are discussed, along with its effectiveness in managing obesity. The future perspective of corn silk anti-obesity effect provides a significant potential for combating global obesity and enhancing public health and wellness.

### Keywords

Corn silk, Flavonoid, Anti-obesity, Adipocytes, Maysin, Public health

### Introduction

The World Health Organisation (WHO) and the National Institute of Health have defined obesity as an excess of fat that increases the risk of illness and death. It is a multifactorial chronic disease caused by many factors, including behavioural, dietary, lifestyle, and genetic medication [1]. Body Mass Index (BMI) is a statistical index used to define a person as underweight, normal weight, overweight, or obese [2]. A body mass index of 30 kg/m<sup>2</sup> or more is considered obese, while a BMI of 25 kg/m<sup>2</sup> is considered overweight [3]. BMI measurements are used to assess overweight or obesity, which gives valuable information about increasing body fatness.

It determines and identifies the individuals and population groups at risk of mortality and morbidity ratios. Globally, overweight and obesity are increasing in developed and developing countries. Overweight and obesity are caused by various factors, which include lifestyle factors like diet, physical activity, parental obesity, and underlying disease conditions [4]. Obesity increases the morbidity and mortality rate worldwide [5]. The most pressing public health issues nowadays are overweight and obesity which are determined by the percentiles of BMI within the population. BMI >95<sup>th</sup> percentile is defined as obesity, and BMI between the 85<sup>th</sup> and 95<sup>th</sup> percentile indicates an increased risk of obesity [6]. In India, the prevalence of obesity varies from urban to rural areas, which is due to numerous types of factors like lifestyle, dietary patterns, and geographical conditions. Obesity is one of the major health issues that is mostly ignored and causes diseases like diabetes and cardiovascular ischemic heart disease [2].

The WHO estimated, that 650 million adults, and 340 million teenagers are overweight or obese in the world, with 39 million children being classified as obese. Furthermore, the WHO predicts that by 2025, an estimated 167 million adults and children will have lost their health status due to obesity or being overweight. Nowadays, edible plant parts are generally used for the treatment and prevention of obesity and many diseases because they have many beneficial effects due to their phytochemical composition [4, 7]. Corn silk is an eco-friendly agricultural waste that can be used for many industrial and commercial uses. Some studies revealed that corn silk has many potential health benefits and is used as a value-added ingredient in many food products. Corn silk (*S. myadis*) is composed of a long silky hair like structure ranging from yellowish to reddish in colour that covers the dietary part of maize [8]. It belongs to the family Poaceae, or Gramineae. Corn silk is widely regarded as a traditional Chinese medicine that is often used for various purposes, like herbal medicine and food ingredients.

Corn silk is widely rich in pharmacological properties due to the presence of flavonoids. Along with some natural antioxidants, corn silk also contains various fixed volatile substances, alkaloids, compound steroids like Sitosterol and stigma-sterol, and saponins. It contains maizeric acid, resin, sugar, mucilage, and fibre. Additionally, corn silk contains flavonoids that have biological uses like antioxidant, antibacterial, antidiabetic, and anti-fatigue [9].

The aetiology of obesity is multifaceted because of the various factors as shown in figure 1 modern existence, including a lack of physical activity, a sedentary lifestyle, and improper dietary patterns that increase the risk of obesity. Many people are suffering from genetic obesity, which is characterised in two parts. The monogenic type and the polygenic type generally occur due to the urge to consume unlimited food in large amounts, which decreases physical activity [10]. The age and rate of development of excessive adiposity are affected by Environmental factors, behavioural factors, and genetic factors determining the adiposity. Inherited and acquired are etiologic subtypes. After puberty, the development of excessive adiposity refers to the acquired obesity. In this subtype, food

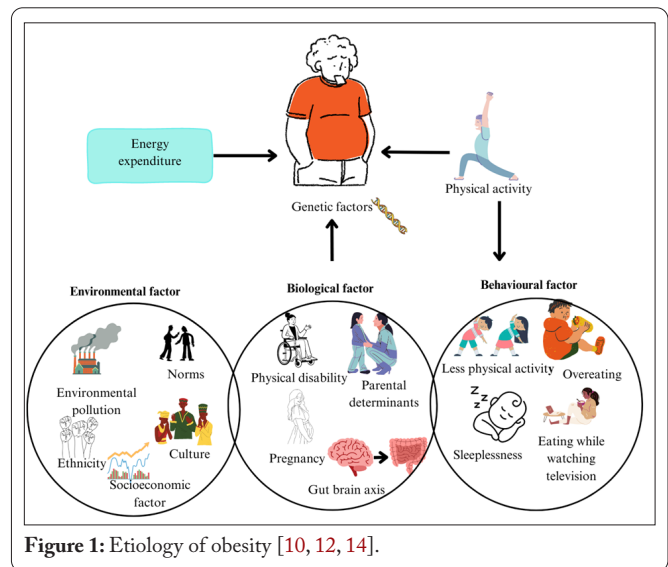


Figure 1: Etiology of obesity [10, 12, 14].

and exercise are used as a medication and in inherited obesity, adiposity exists at birth and throughout pubescence [11].

There are various complications that can be caused by obesity, like type 2 diabetes, cardiovascular disease, metabolic effects, anatomical effects, gastrointestinal complications, shortness of breath, joint problems such as osteoarthritis, cancer, gastroesophageal reflux, liver disorders, gall bladder diseases, reproductive system disorders, social and economic problems, and psychological problems, as shown in figure 2 [12]. Overweight and obese people have a high risk of cardiovascular disease, heart failure, coronary heart disease, and premature death. Excess weight can build plaque in the arteries and reduce blood flow in the body. Obesity is a risk factor for osteoarthritis.

When the weight is increased, the pressure in the joints increases, which leads to joint pain, particularly in the hip joints, and stiffness in the knee. Obesity can negatively impact respiratory function. Obstructive sleep apnea may lead to the

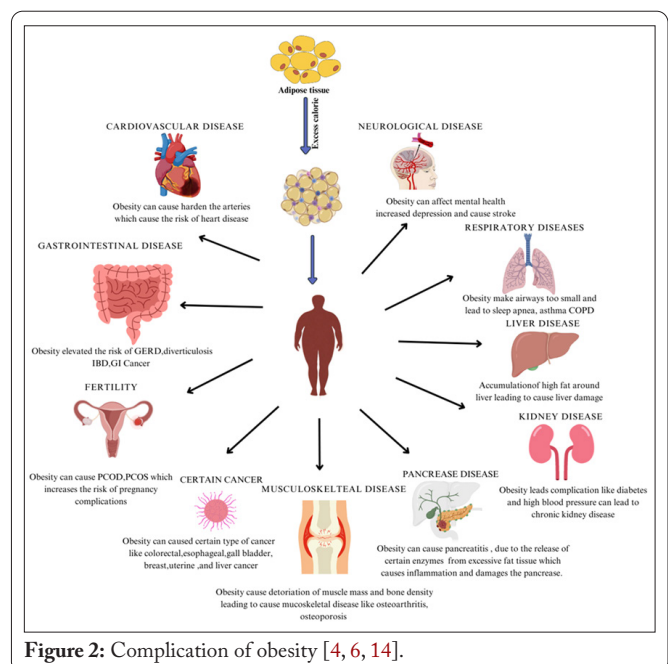


Figure 2: Complication of obesity [4, 6, 14].

accumulation of CO<sub>2</sub> in the bloodstream and the body getting more oxygen than it can use. And it also increases the risk of developing asthma. Obesity has been identified as a contributing factor to the development of gallbladder disease due to a blocked bile duct. The bile duct is responsible for transporting bile from the liver to the duodenum. And it also leads to GERD, fatty liver disease, steatohepatitis, and pancreatitis. Various neurological diseases occur due to obesity, which increases the risk of dementia and Alzheimer's disease [6]. Obesity can also cause reproductive complications like PCOS, menstrual irregularities, and infertility PCOS, menstrual irregularities, and infertility [13].

### Effect of corn silk on obesity

Corn silk contains phytochemicals, namely flavonoids, apigenin, genistein, catechin, quercetin, and anthocyanin, which have a potential role as anti-obesity agents. These phytochemicals play a role in the adipocyte life cycle, how they combat the formation of fatty tissue (adipogenesis), and lipid breakdown (lipolysis) [7]. Energy intake, energy expenses, and biophysical adipose tissue are three features involved in excessive body weight. Maysin maize silk extract inhibits Activating Protein-2 (AP2) in the liver and adipose tissue, which suppresses lipogenesis in the adipose tissue. Intake of excess maysin maize silk extract reduced the flavonoids present in the medicinal herbs, which are responsible for the pharmaceutical's properties. Flavonoids are common medicinal herbs, about 4000 flavonoids have been extracted from medicinal herbs. Numerous flavonoids with powerful antioxidant and anti-inflammatory properties have a potential benefit for the treatment or prevention of obesity because oxidative stress and chronic low-grade inflammation are considered key mechanisms in the pathogenesis of obesity [14, 15].

### Role of corn silk on gut microbiota

In High Fat Diet-fed (HFD) mice, corn silk extract has a beneficial effect on the weight of the body, cholesterol levels, the microbiota of the intestine, and waste metabolomics. Obesity and hypercholesterolemia are strongly interrelated. In HFD C57BL/6J mice, this alters the gut microbiota composition, metabolic syndrome, hepatic steatosis, and obesity in the HFD mice. The composition of the microbiota is modified, such as the quantity and composition of lipids. Lipids influence the gut microbiota by acting as substrates for suppressing bacterial growth. These studies revealed that in humans and mice change lipid metabolism and the level of lipids in their blood and tissue in conditions like dyslipidemia, hyperlipidemia, atherosclerosis, and non-alcoholic liver diseases [16]. Some studies revealed that high-fat diets induce intestinal dysbiosis before the onset of obesity and its metabolic complications. Natural flavonoids can help to maintain the host's gut health by influencing the quantity of gut microbiota, reducing ameliorate dysbiosis or maintaining the host's gut health. Different types of flavonoids have the ability to promote or inhibit the progression of the gut microbiota [17].

### Role of corn silk on adipose tissue

The development of obesity is significantly affected by

adipose tissue. It's the main source of energy and can be a target for treatment for metabolic diseases. Activated Protein Kinase (AMPK) is a protein that's activated by AMP and plays a key role in metabolic disorders. Some studies revealed that in White Adipose Tissue (WAT) from humans and rodents, AMPK activity decreased. For the management of obesity, it is a very efficient way to enhance AMPK activation in the WAT of obese persons. Purple corn contains a variety of phytochemicals, including cyanidine, -3-glucoside, and peonidin glucoside. These phytochemicals are commonly found in leaves, corn kernels, and seeds. Anthocyanins that are present in purple corn have various potential health benefits. The effect of APM on combating obesity in HFD-induced mice. In addition, AMP induces mitochondrial function in the liver, thereby blocking the activity of fatty acid synthase and thereby promoting fatty acid oxidation through increased phosphorylation of AMPK by inhibiting adipogenic transcription [18].

### Inflammation and obesity

Flavonoids have the ability to change the low-grade inflammation that develops with obesity. Some studies revealed that promoting AMPK phosphorylation and sirtuin1 (SIRT1) expression can reduce the inflammatory responses of macrophages. Additionally, it induces macrophage phenotype switching, which reduces obesity-related hepatic inflammation. 18-week supplementation of quercetin in mice can reduce the number of macrophages in the adipose tissue. Other studies revealed that apigenin decreased malondialdehyde, IL-1, and IL-6 levels and activated the peroxisome proliferator-activated receptor (PPAR) in the high-fat mouse model of metabolic inflammation in the colon. Different isoflavones like daidzein, luteolin, chrysin, and rutin showed anti-inflammatory activity [19]. In a study, it was found that different proinflammatory cytokines like IL-5 (interleukins), IL-10 (interleukin-12, IL-13), IFN- $\gamma$  (interferon- $\gamma$ ), and TNF- $\alpha$  (tumor necrosis factor-alpha) were all closely linked to the obese patients, which had a big impact on their plasma IL-4, IL-10, and IL-13 levels [20].

Flavonoids have anti-obesity potential and can suppress the appetite, decrease the consumption of food, and intestinal fat absorption, by regulating metabolic processes (such as adipocyte differentiation, adipogenesis, lipolysis, and  $\beta$ -oxidation) modify the gut microbiota, increase energy expenditure, and induce no thermogenesis [14].

### Corn silk relation with adipogenesis

Corn silk has great potential to combat against obesity. During the life cycle of the fat cells, they go through several stages of growth and development, including inhibition of proliferation, adipogenesis, lipolysis and apoptosis. Another way it works is to stop pre-adipocyte growth through mitotic division, which is regulated by cyclin-dependent kinases eukaryotic transcription factor 2 and mitotic phase promoting factor. Corn silk has been found to inhibit the growth of preadipocytes, which is linked to polyphenols like quercetin and naringenin and chlorogenic acid. At 40.4  $\mu$ M and 100  $\mu$ M quercetin naringenic acid showed a 50% growth inhibitory effect [7].

### Mechanism of corn silk on obesity

Corn silk possesses anti-obesity properties, in the form of corn silk extract which has a strong relationship with obesity by inhibiting adipogenesis and lipolysis. Leptin is a hormone produced mostly by adipose tissue that is released into the bloodstream. During fasting, leptin levels decrease after consumption of food, and leptin is released, which gives a signal to the brain that decreases appetite. Insulin, glucagon, leptin, and ghrelin are some hormones that regulate appetite and satiety. Some other hormones like glucagon-like peptide-1, gastric inhibitor peptide, and Y.Y. peptide, act on satiety, which is generally present in the gastrointestinal area [21]. The orexigenic neuroprotein released by the gut is called ghrelin. Ghrelin is responsible for hunger [5]. When the ghrelin hormone secretes adenosine monophosphate (AMP-K), it is activated by the enzyme protein kinase. Pro-Opiomelanocortin, neuropeptides, and cocaine and amphetamine-related transcripts act, and both are released by hypothalamus neurons that are linked to food behaviour. Like this, the other neurons in the hypothalamus release the appetite-stimulating neuropeptides Y and agouti-related protein, which may affect and control food intake [22].

*In vitro* studies of maize silk extract and lemon balm were estimated by [23] where they analysed the effect of maize silk extract with lemon balm on the level of C/EBP, C/EBP, PPAR, and Sterol Regulatory Element-Binding Proteins

(SREBP-1c) that are involved in the lipogenesis and adipocytes differentiation M-LB/corn silk reduced body weight when the 1:1, 1:2, 2:1, and 4:1 ratio were given to the female mice. The administration of a ratio of 1:1 is most applicable for the anti-obesity effect. The phytochemical rosamarinic acid and allantoin are present in corn silk. *In vitro* studies revealed that rosamarinic acid inhibits preadipocyte differentiation by decreasing adipogenesis and suppressing inflammation. The anti-obesity effect of corn silk along with lemon balm mitigated HFD-induced obesity as compared to 200 mg/kg Met, which was comparable to that of 100 mg/kg M-LB/corn silk. 200 mg/kg Met was observed to have a potent effect on the management of obesity and metabolic disorders.

High maysin corn silk extract has shown weight reduction when administered at 100 mg/kg and 400 mg/kg body weight for 2 weeks in mice. For the reduction of body fat and body weight, the mechanisms responsible for high maysin corn silk extract, and expression of m-RNA protein levels involved in fat synthesis, lipolysis, fat accumulation, adipocyte differentiation, fat oxidation, and liver were measured. The elevated level of Cluster of Differentiation (CD-36) eliminates the transfer of fatty acids into adipose tissue and stops the formation of fat. It also reduces Fatty Acid Synthetase and Acetyl-coA Carboxylase expression, which diminishes body fat volume and fat production [24] as shown in figure 3.

When maysin is used to treat obesity, it can help reduce

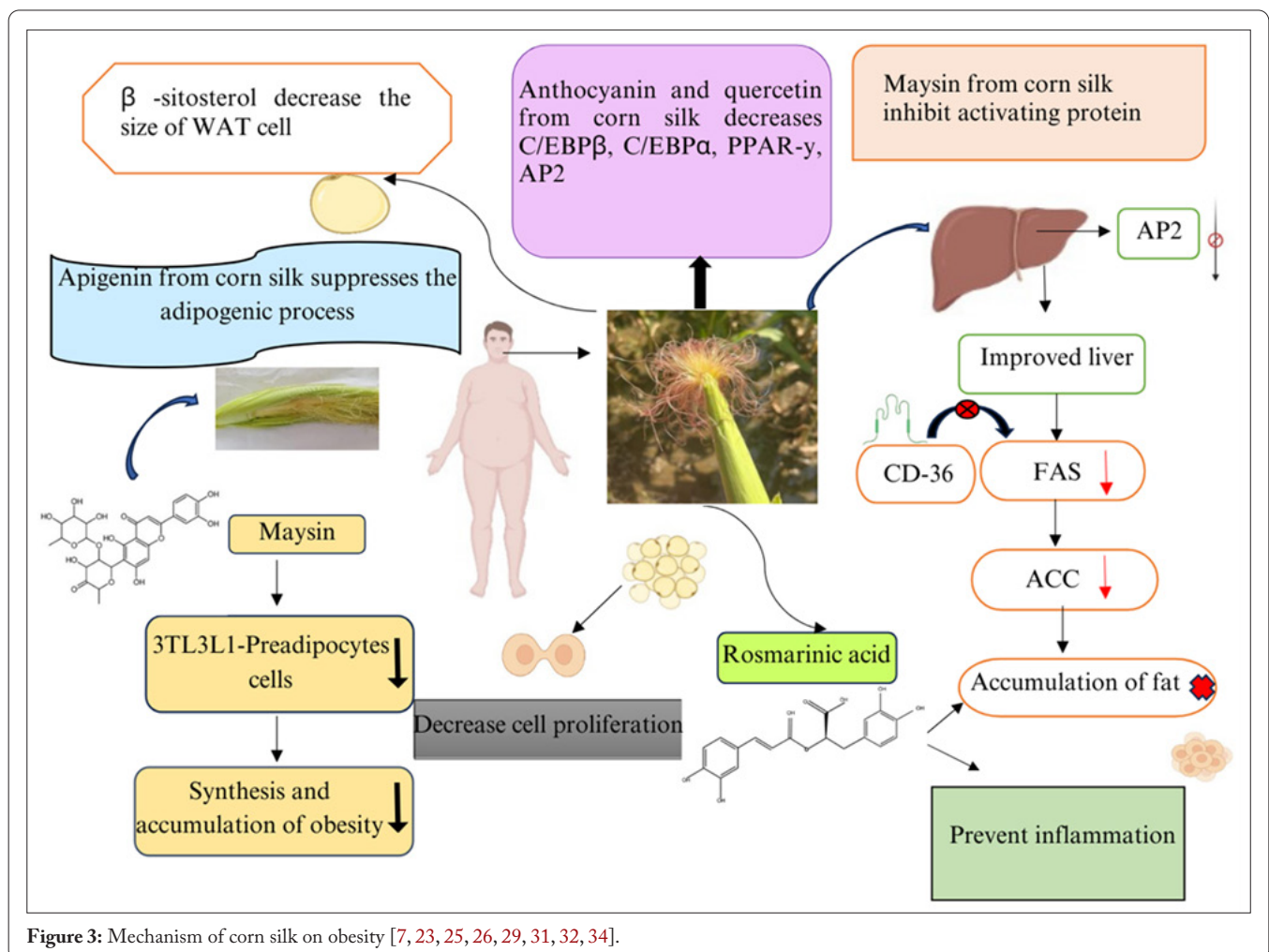


Figure 3: Mechanism of corn silk on obesity [7, 23, 25, 26, 29, 31, 32, 34].

the amount of fat in the body. In a study in mice, maysin was used to reduce serum triglyceride levels and total cholesterol, as well as body weight and fat weight. The mice were fed a high-fat diet and the maysin was infused for the first time, resulting in a decrease in serum triglyceride, total cholesterol, and LDL cholesterol. The maysin was given at doses of 25, 50, 100, and 200 g/ml, and it was found to reduce the viability of cells called 3T3L1 pre-adipocytes cells. It promises that maysin could be a great way to reduce fat mass in the body by reducing cell proliferation, either in pre-adipocytes and mature adipocytes [25, 26]. Purple corn silk contains anthocyanin, quercetin, and phenolic acids these compounds have inhibitory effects on the differentiation of adipocytes [7].

In the experimental rats, the body weight decreased when corn silk extract as an ethanolic extract and vitamin D or corn silk as a tea were used with a combination of vitamin D or individually. A combination of corn silk and vitamin D has been shown to significantly reduce serum TC, TAG, LDL-C, HDLC, and various adipose tissues associated with obesity. The high maysin content of the extract reduces the expression of genes associated with adipocyte recognition, adipocyte accumulation, and fat composition, while simultaneously increasing the expression of genes related to lipolysis, fat oxidation, and decreased stored fat [27]. A high cholesterol diet is given to animals for 12 weeks with the objective of making them obese, and after that, they are given either orlistat, methanolic, or aqueous corn silk extracts for 6 weeks. Anthropometric measurements and biochemical parameters will be measured including the abdominal circumference, thoracic circumference, body mass index, lipid profile, and serum lipid level, which significantly declined ( $p < 0.05$ ) [28].

Ethanolic purple corn silk suppresses abdominal fat cells and adipogenesis by reducing the C/EBP $\beta$ , C/EBP $\alpha$ , PPAR- $\gamma$ , and AP2. It's made up of anthocyanins, quercetin derivatives of phenolic acids (cyanidin, pelargonidin, delphinidin, petunidin, peonidin, malvidin, cyanidin glucoside, cyanidin malonyl glucoside, pelargonidin glucoside, peonidin glucoside, and quercetin). Numerous studies have suggested that corn silk has antidiabetic and hypolipidemic properties that can also prevent or treat metabolic syndrome. Through the inhibition of the gelatin-12 expressions corn silk extract decreases adipogenesis. When crude flavonoids were extracted from mice with STZ-induced diabetes, corn silk extract reduced serum lipid levels, body weight, and primarily blood glucose levels [7] studied shows that the effects of 10 weeks of corn silk extract on obese mice with STZ-induced diabetes.

The results showed a significant decrease in body weight [29]. It also shows that the lipid droplets in the liver cells decrease the size of WAT cells as compared to the control group. A diabetic-metformin treated with diabetic-PRF-corn silk 100 mg/kg (DRFP 100) and 200 mg/kg (DRFP 200) groups. The diabetic rats were administered the doses of 100 and 200 mg/kg PRF-corn silk for 28 days regularly. The result shows significant weight loss as compared to the normal rats. It has a protective effect on decreasing oxidative stress and maintaining the integrity of the liver [30]. Rosmarinic acid prevents the accumulation of lipids and inflammation, the translation of C/EBP, PPAR and adiponectin, along with modification of

TGF1B and IL17A were determined. Treatment of RA shows the involvement of NRF2 signalling [31].

Flavonoids have a positive effect against obesity, among them apigenin also shows anti-obesity and anti-diabetic effects. Normal diet and high-fat diets were given to male C57BL/6J mice. Apigenin (10 mg/kg/day) was administered to SD or HFD mice. This study shows that it suppresses the adipogenic process and regulates blood glucose. Due to this ability, it shows anti-obesity and anti-diabetic properties [32]. Obesity is directly interlinked with the hepatic cholesterol mechanism. Corn silk extract has been shown to help reduce body weight and induce fatty liver disease when given as an oral treatment for 8 weeks with a high-fat diet. It also helps to improve the levels of glucose and insulin in the body. And, it helps to reduce the amount of fat in the blood and increases the amount of leptin in the blood [33]. A bioactive compound from corn silk maysin showed a weight reduction effect when the treatment of corn silk was given for 8 weeks in high fat diet-induced mice it declined the body weight, epididymal fat weight. It shows that maysin has a weight reducing effect by reducing the body's ability to store fat. Additionally, corn silk extract shows a weight-reducing impact when administered at 100 - 400 mg/kg body weight every two weeks to mice [34].

### Application and utilisation

Corn silk is an agricultural material obtained during the harvesting of corn in abundant amounts. Corn silk is used for commercial purposes. It contains a wide range of bioactive compounds, vital nutrients, and other natural antioxidants like polyphenols and flavonoids [9]. Corn silk is a traditional herb that can be used to treat various diseases [35]. Bioactive compounds are considered a functional food source that can be used for many pharmacological properties. Some studies revealed that corn silk is used in many foods' formulations like bread, crackers, tea, wine, vinegar, meat balls, beef patties, oil, and common foods like parathas chapati, raita, and dhal. Corn silk is used in both the dietary sector and the non-dietary sector. In the food industry it is utilised in the form of bakery products, beverages, meat products, oil products, and traditional food products. In the non-food industry, it is used in the form of cosmetic products, oil absorbents, and livestock feed [9]. Both lemon balm and corn silk are effective medicinal herbs that are used for their anti-obesity effects and positive effects on human health. Oral administration of a combination of corn silk and lemon balm reduced adipocyte hypertrophy and weight gain without changing food consumption [23].

Various health conditions such as obesity, weight loss, lowered immunity and diabetes, cancer, gastrointestinal diseases, kidney stones, cystitis, and prostate disorders are treated with fresh or dried corn silk. Flavoured corn silk tea is prepared with various ingredients like clove, Tulsi, and Gandhari, the combination of herbs with the corn silk increases the palatability and positive impacts on health [36]. An ingestible expandable capsule is made for weight loss, as the membrane of this capsule is made up of a collagen casing and is tied with corn silk. The Most expanded material is black fungus (*Auricularia auricula*). The best core material was a synthetic hydrogel made of cellulose that expand more. After soaking it for 80

min in an acidic environment, the hydrogen based endoxpan expanded 72 times. After 3 h of corn silk ligations, it will break and weaken resulting in the release of expanded material that was intended to pass through the pylorus and move down the gastrointestinal tract for digestion or excretion [37].

One of the most consumed foods in the world is pasta. The pasta is generally made up of combination of corn silk powder with durum wheat semolina which enrich the nutritional quality of the pasta. Studies revealed that the corn silk powder had more mineral elements than durum wheat semolina. The Addition of corn silk powder to durum wheat semolina significantly increases the protein, ash, and fibre content and decreases the carbohydrate content and energy value. This increases the nutritional quality and improves the health conditions [38]. 3T3-L1 adipocytes treated with corn silk, JT, LE, and AP, developed bread extract which contains corn silk, adlay, shiitake mushroom, and apple peel respectively, adipogenesis was analysed. Among the tested samples (corn silk, JT, LE, and AP) it shows that corn silk reduced the adipocyte differentiation in 3T3-L1 it prevented the adipocyte differentiation in a concentration-dependent manner. At concentrations of (10, 50, and 100 µg/ml) doses of corn silk affect the level of C/EBP, PPAR, and AP2 mRNA and protein during the differentiation of adipocytes. In 3T3-L1 adipocytes the PPAR $\alpha$  and AP2 mRNA expression decreases after corn silk treatment. Corn silk bread is suggested as a healthy bread that can prevent diseases caused by oxidative stress and obesity [24].

### Toxicity safety evaluation and recommendation

Acute toxicity of corn silk extract was demonstrated in both female and male rats. Single intragastric administration of liquid extract at doses up to 5.0 ml/kg did not show any death in the male or female rats. All groups of animals show physiological excess weight. Food and water are actively consumed by white rats. After one hour of injection, they responded appropriately to external stimuli. Their behavioural responses, social interactions, and body temperatures are normal. According to research studies, the amount of 5.0 ml/kg have been shown to be non-toxic [39].

Corn silk has been found to be sub-chronic toxic to rats (Wistar rats) at concentrations ranging from 0.5 to 8% (w/v). This toxicity was observed over a period of 90 days in both male and female rats. A variety of tests were conducted to assess the general health of the rats, as well as their haematological, organ and weight status, as well as food consumption. Additionally, gross microscopic examination of tissues and blood chemistry were also included [8].

The oral acute toxicity test was assessed by dividing 12 rats into five groups (6 males and 6 females). The rats in each group were fasted overnight for this test and they got a single dose of corn silk extract (500, 1000, 2000, and 5000 mg/kg). Oral administration of 5 g/kg of corn silk extract shows no death in the rats. There is no toxicity seen within 24 h or after 14 days [8].

### Conclusion

Corn silk has a promising natural anti-obesity effect. These

studies revealed that corn silk has a variety of bioactive compounds that have the capacity to regulate adipocytes, control lipid absorption, and regulate appetite which may be beneficial for weight management. Corn silk has many health benefits from its antioxidants and anti-inflammatory properties. The high-fat diet intervention with corn silk extract improved the metabolic disorders. Nowadays, as the demand for plant-based treatments increases, they may become a substitute for anti-obesity medications and have higher acceptance by consumers due to fewer side effects making it easier to regulate them in a better way. Corn silk has a phytochemical component that has anti-obesity effects it suppresses adipogenesis, stimulates lipolysis and reduces inflammatory and oxidative stress factors. According to studies, corn silk has no side effects when consumed in an appropriate way. The formulation of corn silk-based products such as dietary supplements or any functional food can be beneficial for weight management.

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### Conflict of Interest

There is no conflict of interest among authors

### References

1. Chaitianan R, Chayopas P, Rattanathongkom A, Tippayawat P, Sutthanat K. 2016. Anti-obesity potential of corn silks: relationships of phytochemicals and antioxidation, anti-pre-adipocyte proliferation, anti-adipogenesis, and lipolysis induction. *J Funct Foods* 23: 497-510. <https://doi.org/10.1016/j.jff.2016.03.010>
2. Ahrwar R, Mondal PR. 2019. Prevalence of obesity in India: a systematic review. *Diabetes Metab Syndr* 13(1): 318-321. <https://doi.org/10.1016/j.dsx.2018.08.032>
3. Sarma S, Sockalingam S, Dash S. 2021. Obesity as a multisystem disease: trends in obesity rates and obesity-related complications. *Diabetes Obes Metab* 23(Suppl 1): 3-16. <https://doi.org/10.1111/dom.14290>
4. Kumar M, Kaushik D, Kaur J, Proestos C, Oz F, et al. 2022. A critical review on obesity: herbal approach, bioactive compounds, and their mechanism. *Appl Sci* 12(16): 8342. <https://doi.org/10.3390/app12168342>
5. Alsolami K. 2023. Highlights on obesity: pathophysiology, obesity in diabetes and maternal obesity. *HIV Nurs* 23(2): 870-880.
6. Kinlen D, Cody D, O'Shea D. 2018. Complications of obesity. *QJM* 111(7): 437-443. <https://doi.org/10.1093/qjmed/hcx152>
7. Chaitianan R, Sutthanat K, Rattanathongkom A. 2017. Purple corn silk: potential anti-obesity agent with inhibition on adipogenesis and induction on lipolysis and apoptosis in adipocytes. *J Ethnopharmacol* 201: 9-16. <https://doi.org/10.1016/j.jep.2017.02.044>
8. Kaur P, Singh J, Kaur M, Rasane P, Kaur S, et al. 2023. Corn silk as an agricultural waste: a comprehensive review on its nutritional composition and bioactive potential. *Waste Biomass Valor* 14: 1413-1432. <https://doi.org/10.1007/s12649-022-02016-0>
9. Singh J, Inbaraj BS, Kaur S, Rasane P, Nanda V. 2022. Phytochemical analysis and characterization of corn silk (*Zea mays*, G5417). *Agronomy* 12(4): 777. <https://doi.org/10.3390/agronomy12040777>
10. Abdullah RA. 2022. Review of literature: etiology of obesity, risk factors, and the role of genetics. *GSC Biol Pharm Sci* 21(02): 197-201. <https://doi.org/10.30574/gscbps.2022.21.2.0443>

11. Archer E, Lavie CJ. 2022. Obesity subtyping: the etiology, prevention, and management of acquired versus inherited obese phenotypes. *Nutrients* 14(11): 2286. <https://doi.org/10.3390/nu14112286>
12. Kumar M, Guleria S, Chawla P, Khan A, Kaushik R. 2020. Severity, types, factors affecting and strategy to overcome obesity. *Plant Arch* 20(1): 657-672.
13. Kumar M, Guleria S, Chawla P, Khan A, Modi VK, et al. 2020. Anti-obesity efficacy of the selected high altitude Himalayan herbs: *In vitro* studies. *J Food Sci Technol* 57: 3081-3090. <https://doi.org/10.1007/s13197-020-04341-5>
14. Liu J, Cao J, Li Y, Guo F. 2023. Beneficial flavonoid in foods and anti-obesity effect. *Food Rev Int* 39(1): 560-600. <https://doi.org/10.1080/87559129.2021.1923730>
15. Dinda B, Dinda M, Roy A, Dinda S. 2020. Dietary plant flavonoids in prevention of obesity and diabetes. *Adv Protein Chem Struct Biol* 120: 159-235. <https://doi.org/10.1016/bs.apcsb.2019.08.006>
16. Ding L, Ren S, Song Y, Zang C, Liu Y, et al. 2022. Modulation of gut microbiota and fecal metabolites by corn silk among high-fat diet-induced hypercholesterolemia mice. *Front Nutr* 9: 935612. <https://doi.org/10.3389/fnut.2022.935612>
17. Wang Y, Li T, Liu Y, Yang C, Liu L, et al. 2022. Heimaao tea polysaccharides ameliorate obesity by enhancing gut microbiota-dependent adipocytes thermogenesis in mice fed with high fat diet. *Food Funct* 13(24): 13014-13027. <https://doi.org/10.1039/D2FO02415B>
18. Kim HY, Lee KY, Kim M, Hong M, Deepa P, et al. 2023. A review of the biological properties of purple corn (*Zea mays* L.). *Sci Pharm* 91(1): 6. <https://doi.org/10.3390/scipharm91010006>
19. García-Barrado MJ, Iglesias-Osma MC, Pérez-García E, Carrero S, Blanco EJ, et al. 2020. Role of flavonoids in the interactions among obesity, inflammation, and autophagy. *Pharmaceuticals* 13(11): 342. <https://doi.org/10.3390/ph13110342>
20. Paul AK, Jahan R, Paul A, Mahboob T, Bondhon TA, et al. 2022. The role of medicinal and aromatic plants against obesity and arthritis: a review. *Nutrients* 14(5): 985. <https://doi.org/10.3390/nu14050985>
21. Miguéns-Gómez A, Casanova-Martí A, Blay MT, Terra X, Beltrán-Debón R, et al. 2021. Glucagon-like peptide-1 regulation by food proteins and protein hydrolysates. *Nutr Res Rev* 34(2): 259-275. <https://doi.org/10.1017/s0954422421000019>
22. Rufino AT, Costa VM, Carvalho F, Fernandes E. 2021. Flavonoids as antiobesity agents: a review. *Med Res Rev* 41(1): 556-585. <https://doi.org/10.1002/med.21740>
23. Cho JJ, Kim SE, Choi BR, Park HR, Park JE, et al. 2021. Lemon balm and corn silk extracts mitigate high-fat diet-induced obesity in mice. *Antioxidants* 10(12): 2015. <https://doi.org/10.3390/antiox10122015>
24. Lee CW, Park YI, Kim SH, Lim H, Chung MJ. 2016. Antioxidant and anti-adipogenic activities of bread containing corn silk, Job's tears, *Lentinus edodes*, and apple peel in 3T3-L1 preadipocytes. *J Korean Soc Food Sci Nutr* 45(5): 651-663. <https://doi.org/10.3746/jkfn.2016.45.5.651>
25. Lee EY, Kim SL, Kang HJ, Kim MH, Ha AW, et al. 2016. High maysin corn silk extract reduces body weight and fat deposition in C57BL/6J mice fed high-fat diets. *Nutr Res Pract* 10(6): 575-582. <https://doi.org/10.4162/nrp.2016.10.6.575>
26. Lee CW, Seo JY, Kim SL, Lee J, Choi JW, et al. 2017. Corn silk maysin ameliorates obesity *in vitro* and *in vivo* via suppression of lipogenesis, differentiation, and function of adipocytes. *Biomed Pharmacother* 93: 267-275. <https://doi.org/10.1016/j.biopha.2017.06.039>
27. El Kewawy HE. 2018. Evaluation of the efficacy of corn silk vitamin D on hyperlipidemia and obesity in experimental rats. *J Food and Dairy Sci* 169-175.
28. Ahmed HH, Hamza AH, Kotob SE. 2016. Corn silk offers multimechanistic approaches in mitigating obesity in rodents. *Asian J Pharm Clin Res* 9(4): 292-298.
29. Hsu YA, Kuo YH, Chen CS, Chen YC, Huang CC, et al. 2018. Galleitin-12 is involved in corn silk-induced anti-adipogenesis and anti-obesity effects. *Am J Chin Med* 46(5): 1045-1063. <https://doi.org/10.1142/s0192415x18500544>
30. Hamzah N, Safuan S, Ishak WRW. 2023. Protective effects of the polyphenolic-rich fraction of cornsilk against oxidative stress in Streptozotocin-induced diabetic rats. *J Gizi Pangan* 18(1), 41-50. <https://doi.org/10.25182/jgp.2023.18.1.41-50>
31. Vasileva LV, Savova MS, Tews D, Wabitsch M, Georgiev MI. 2021. Rosmarinic acid attenuates obesity and obesity-related inflammation in human adipocytes. *Food Chem Toxicol* 149: 112002. <https://doi.org/10.1016/j.fct.2021.112002>
32. Gentile D, Fornai M, Colucci R, Pellegrini C, Tirota E, et al. 2018. The flavonoid compound apigenin prevents colonic inflammation and motor dysfunctions associated with high fat diet-induced obesity. *PLoS One* 13(4): e0195502. <https://doi.org/10.1371/journal.pone.0195502>
33. Cha JH, Kim SR, Kang HJ, Kim MH, Ha AW, et al. 2016. Corn silk extract improves cholesterol metabolism in C57BL/6J mouse fed high-fat diets. *Nutr Res Pract* 10(5): 501-506. <https://doi.org/10.4162/nrp.2016.10.5.501>
34. Mada SB, Sani L, Chechet GD. 2020. Corn silk from waste material to potential therapeutic agent: a mini review. *FUV Trends Sci Technol J* 5(3): 816-820.
35. Singh A, Raghuvanshi RS. 2020. Influence of corn silk powder supplementation on sensory and chemical characteristics of developed food. *Int J Curr Microbiol Appl Sci* 11: 1072-1081.
36. Singh A, Raghuvanshi RS, Bhatnagar A. 2021. Herbal tea formulation using different flavoured herbs with dried corn silk powder and its sensory and phytochemical analysis. *Syst Microbiol Biomanuf* 1(3): 336-343. <https://doi.org/10.1007/s43393-021-00029-9>
37. Liu X, Wu Y, Liu C, Chen K, Gregersen H. 2022. Development of an ingestible expandable capsule for weight loss. *Int J Environ Res Public Health* 19(24): 16821. <https://doi.org/10.3390/ijerph192416821>
38. Rozan MA, El-Shshtawy T, Boriy EG. 2022. Nutritional value, antioxidant activity, cooking quality, and sensory attributes of pasta enriched with cornsilk. *Egypt J Food Sci* 50(2): 283-297. <https://doi.org/10.21608/ejfs.2022.170239.1142>
39. Abudayah ZH, Karpiuk U, Kyslychenko V, Abualassal Q, Hassouneh LK, et al. 2022. Optimizing extractability, phytochemistry, acute toxicity, and hemostatic action of corn silk liquid extract. *J Chem* 2022: 3059725. <https://doi.org/10.1155/2022/3059725>