Development of Value Added Herbal Products by Incorporating Corn Silk

V. Sivaranjani

(17PFD018)

Thesis Submitted to

Avinashilingam Institute for Home Science and

Higher Education for Women

Coimbatore – 641 043.

In Partial Fulfilment of the Requirements for the

Degree of Master of Science
in
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Certified as a Bonafide Research work

Radha Ramadas

Signature of the
Supervisor

Radha Ramadas 04.04.2019

Signature of the
Head of the Department

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I INTRODUCTION

The word herbal has been derived from Latin word “Herba”. Herbs are part of the plant like seed, flower, leaf, root, and non woody plant. Some of the medicinal herb is used as food flavonoid and which acts as preventive measures for the diseased condition. Therefore there is a need for development of herbal food product by introducing a new method of preparation and innovation. Herbal product design refers in the process of developing, standardizing, and processing of the product towards market. Herbal products are dietary supplements that enhances health, physical appearance, weight loss and development in well being individually. Herbal products can be developed and formulated in the way of tablets, capsules, powders and teas (Zahid, 2016).

Natural health remedies and the use of herbal health products have seen a dramatic growth in popularity over the past decade, perhaps due to the fact that modern medicine has been seen to place more importance on prescribing drugs instead of focusing on disease prevention and healthy diets. Chia seeds (*Salvia hispanica*), hemp seeds (*Cannabis Sativa*), wheatgrass and pomegranate now a staple in many grocery stores have been labeled and marketed as “super foods”, natural ingredients that are rich in antioxidants or contain high levels of nutritional benefits. There is ample evidence that these plants produce beneficial compounds that act as a natural defense mechanism against things like disease and fungal infections. Traditional Chinese medicine and Indian Ayurveda also form the basis for the most commonly practiced forms of natural medicine today (Wegener, 2017).

Now a days value addition food products are introduced to enhance the nutritional value, quality and shelf life of the products. Value addition can be done by the use of preservative or by fortifying using micronutrients, therefore food processing industries generating by products from fruits and vegetables etc. these by products have less use and create considerable environmental pollution. Some of the by products like hull, husk, pods, peel, shell, seeds, stem etc., it can promote to formulate health and physiological active foods and demand of natural bioactive compounds. These by products might have rich source of dietary fibers and other nutritional components in the ingredients(Anilakumar, 2017).

Corn is one of the most growing crops in the world and it becomes third most cereal crop other than wheat and rice(Ramessar*et al*., 2008). Corn commonly known as maize (*Zea mays L*.,) is annual crop belongs to grass family Graminae. The word Zea mays orginates from ancient greek, *Zea*means sustaining life – *mays* come from language Taino meaning life giver. Maize is essential with nutrients for humans and animals. Maize has overall culinary aspects all over the world.There are different types of corn varieties. The major corn production states includes Uttar Pradesh, Bihar, Rajasthan, West Bengal where Karnataka and Jammu & Kashmir provides highest percentage of corn production (Milind,2013).Maize is mother grain of Americans and considered as earliest cultivar of the world. Maize has short lifecycle and requires warm weather Production of corn was reported to increase from 713 thousand metric tons in 2007 to nearly 820 thousand metric ton in 2011(Kumar *et al*., 2013).

Corn silk is considered as the waste by product of maize (corn) and it is also one of the essential cereal and edible grains. Corn silk is long yellowish thread like structure from female flower of maize. In immature stage corn silk possess light green colour after matured stage colour changes from yellow to purple then to brown. Silk thread length is 30 cm depends upon the type of corn varieties (Sani, 2016).

Corn silk will be seen at the end of the corn ear and it is monoecious. It is protandrous in nature that is male flower mature earlier than female flower. The male flower produce yellow pollen, where female flower produce corn silk. It can be used in fresh or dried whenever it is needed.Each silk of corn may be pollinated to produce one kernel of corn (Kaur*et al*., 2015).

Corn silk powder is processed and causes some changes in their chemical characteristics depends upon the variety of corn silk. The changes takes place due to different processing techniques to prepare corn silk powder. Drying is the one of the most effective method to dry the products where it eliminates the moisture and therefore it extends the shelf life of the powder(Haslina, 2017).

The therapeutic effects of many traditional herbs are presence of natural antioxidants, especially phenol compounds. One of the herbs is corn silk consumed for long time as therapeutic remedy for various illnesses and is important as an

alternative natural treatment. It has been used as traditional medicine in many parts of the world such as China, Turkey, United States and France (Wang *et al.*,2011).

Corn silk is excellent source of many bioactive compounds such as volatile oils, steroids and other natural antioxidant such as flavonoids and other phenol compounds and which is more beneficial to human health and it acts as preventive measures (Rosli*et al.*, 2012).

Corn and the other parts are used in various food preparations, agricultural and medicinal. It contains some minerals such asCalcium, Magnesium and Phosphorus were present at 95, 345 and 398.62 mg/100g respectively (Hooda*et al.*, 2013). It has moisture content of 9.65 per cent, 17.6 per cent protein, 0.29 per cent fat, 3.19 per cent ash and 40 per cent dietary fiber.

Corn silk has been used as a remedy for urinary tract ailments including bed wetting, painful, frequent urination, stones, bloating and liver problems. Corn silk is used as diuretic property and it is effective for weight loss and obesity corn silk helps to reduce blood pressure reduce fluid retention in body and eliminates the toxin. The importance of corn silk in medicinal field is justified. It is not only a natural herb, but also safe herb which does not produce drastic side effects because of its chemical structure(Vijitha*et al.*, 2017).

Corn silk extract market, global industry trend analysis 2012 to 2017 and forecast 2017 to 2025 determined that more over corn silk is used as an extract in various products, such as dietary supplements and teas. The potential use of corn silk extract is related to its properties. On the basis of corn silk extract can be segmented into corn silk extract powder and liquid corn silk extract due to change in the market trend, people are more interested in natural products. There is less awareness among population about corn silk extract could be considered as restraint for the market. Depending upon the geographical regions, global corn silk extract market is segmented into some regions North America, Latin America, Western Europe, Eastern Europe, Middle East and Africa(MEA), Asia Pacific except Japan(APEJ). The local manufacturers could be key players in developing corn silk extract and some of the manufacturers are active herb technology, Bristol Botanicals Limited(Food Innovation, 2018).

Product development has a major role to play in the food industry and develops a numerous new product into the market by using advanced technology with the gradual increase in the strategic food production area. The introduction of new product in the way of innovative criteria promotes the marketing level and this too satisfies the needs, wants, and wish of the customer. Therefore, there will be constant changes in the product, inclusion of mixed products and continuous product promotion takes places in the supermarkets(Guine,2016).

There is a major up gradation in product development process due to economical and development of technology changes. For example as a working woman she needs convenience food to take over, thus the food should undergo food processing technologies to prevent from spoilage and enhance the shelf life of the product. In past few years, development of new food product in the market faces both success and failure at marginal level, depends upon the organization and selection of the food for the development and introduction of low value foods at reasonable rate becomes successful but at the same time poor reputation in food industry is regulated. Currently a competitive social and technological food service development is growing, therefore food has been served at door step at reasonable price, and the people prefer more advanced technology and accepting the changes in the developing country (Verma,2010).

In the food industry, innovation is the one of the enhancing competitive advantage against other developing industry. Hence, new product development is the most important process for many industries. In many studies the introduction of new product productivity is decreasing due to improper process development and quality standards (Copper *et al.,* 2001).

Product innovation in the development process is necessity in today's competitive food markets, the consumers are in need of variety and changes in the quality of the product (Howieson*et al.*, 2014). Product innovation involves in two forms – food packaging innovation techniques and food product innovation. Packaging materials should enhance the shelf life, and quality of the product. It should represent the product in new and innovative way. Material should improve versatility. Packaging material improves the usage of facilities.

New product development should represent ethnic concept, enhance the quality and standardization of the product. Introduction of new advanced technology should improve the sensory qualities such as heat treatments, freeze drying (Wrinkles, 2001).

There is an association strategic between new product development and consumer innovative behaviour and the impact of new product development on consumer's adoption and innovative behaviour cannot be over emphasized. In this competitive industry, development of new product in the market is riskiest among the industries, whereas consumers innovative behaviour explains the degree to social system are adopting towards the new product (Amue*et al.*, 2012).

Thus the present study is an attempt to create novel food products by value addition with corn silk powder and to analyse the nutritional composition and shelf life of the productto be essential for the healthy life.

Hence the present study has been undertaken with the **broad objective** of

- Development of Value added herbal products and assess its acceptability and nutrients content.

The **specific objectives** of the study are to

- Prepare corn silk powder.
- Analyze the nutritive value of corn silk.
- Develop product by incorporating the corn silk powder.
- Observe the shelf life of the corn silk powder and value added herbal product and
- Estimate the nutrient contents of the value added herbal product using corn silk powder.

II REVIEW OF LITERATURE

The literature pertaining to the study entitled **"Development of Value Added Herbal Products by Incorporating Corn Silk"**, is reviewed under the following heading:

A. Production and availability of corn silk in India

B. Development of corn silk from field corn and its traditional uses

C. Therapeutic uses

A. Production and Availability of Corn Silk in India

Corn silk is an agricultural waste and residue after consuming the maize cob. More than two third of the maize produced in India is consumed for feed and other industrial uses. Feed industry with a CAGR of 6-7% globally and within India at a CAGR of nine percent presents a huge opportunity for maize growers. With the largest global livestock population, India has always remained a feed starved country. Besides, the Indian poultry industry i.e. eggs and poultry meat sector is growing at a CAGR of around six percent and nine percent respectively. Therefore these factors maize will continues to remain an important crop for food, feed and fodder purposes. The human-edible husked corn cob is only 15percent, while the remaining 85% constitutes of outer peel/husk with a silky thread-like structure called corn husk with silk.Three to four corn ears are hand-picked as soon as 2-3 cm silk emerges from the ear tips. The husk and silk are removed from the corn cob. The husked cobs are cut to specific size in the food processing plant and to domestic market for human consumption. The husked young ears of corn are eaten either fresh, as salad, in soup, or as vegetable and is considered a delicacy. The husk with silk constitutes 85-90% of the ear. The average yield of corn husk with silk is 5-5.5 tonnes/ha. Corn husk with silk is chopped for feeding to livestock.Various agricultural waste products have been used for the preparation of food products as well as their application in the removal of various metals and other pollutants such as dyes from the aqueous solutions.(FICCI, 2018).

B. Development of Corn Silk from Field Corn and its Traditional Uses

*Stigma maydis*also know as corn silk is plant used in medicine from the time of ayurveda, the ancient system of Indian medicine. Corn silk is produced from female parts of the corn plant. It is long and shiny fibers found at the top of the corn ear. Therefore, the flowers of corn are monoecious in which male and female flowers in the stalk. Male flowers will be seen at top of the plant produce yellow pollen, meanwhile the female flowers will produce corn silk. Silk are long stigma where hair like structure, as it is waste by products of corn and still possess large number of medicinal properties to cure the diseased condition.

Corn silk is been used as medicinal value to cure disease, therefore further studies have been conducted to be useful for beneficial aspect. some of the traditional uses of corn silk includes:-

- Corn silk is useful for bladder irritation.
- Corn silk tea helps to lower oxidative stress and prevents onset of cancer.
- It strengthen as well as restore mucos membrane of urinary tract that helps in prevention of incontinence
- It is much useful for prostatitis and against tumour.
- It can be used to produce products such as soap, toothpaste, corn silk powder and other cosmetics.
- It is effective for diarrhea and weight reduction (Kaur, 2015)

C. Therapeutic uses

- Corn silk can be utilized in renal problems for both adult and children and it is also helpful in gentio urinary complaints.
- Corn silk minimizes edema,gout,cystitis etc.,
- Corn silk extract provides smooth texture and helps in skin maintenance
- Corn silk oil is used for treating dandruff. (Milind, 2013)

Hayat *et al*.(2012) observed that *Zea mays* possess antifungal,antiviral,diuretic and antitumour activity. To identify these properties the various standardization parameters of corn silk like macroscopial, microscopial, physicochemical parameters

and successive extractive values in various solvents like petroleum ether(2.1%),benzene(2.4%),chloroform(2.9%),ethyl acetate(3.4%),methanol(28.5%). Therefore preliminary phytochemical screening is done for detection of various plantconstituent which can be responsible for pharmacological usage as drug. Hence result shows that in preliminary phytochemical screening of corn silk,all the phytoconstituents positively observed by using methanol extract as solvent.So it may be scientifically proved to access the pharmacological responses of the plant to ascertain its folklore uses.

Bhaigyabati*et al*.(2011) screened the phytochemicals,free radical scavenging activity and total antioxidant activity by using solvents. The results shows that phytochemical were extracted best in positively methanol,and for free radical scavenging activity the methanolic extract of corn silk with 100µg concentration gives higher percentage(95.6%) than other extracts.

The study was undertaken by Sarepoua*et al*.(2013) to find out the total phenolics, total flavonoids, total anthocyanin and antioxidant activities in selectedpurple waxy corn and baby corn. The results have shown that baby corn and purple waxy corn have highest antioxidant activity. In addition, purple waxy corn had total phenolic content,total flavonoid content and total anthocyanin content. Therefore purple waxy corn and baby corn are higher for corn silk production for use in functional food, nutraceutical industries and for breeding program in future.

Rahman*et al*.(2013)descirbes the nutritional composition and antioxidative capacity of the silk from immature and mature corn. From the result it shows that both immature and mature silk considered as good source of nutritional composition and antioxidant capacity. The immature silk contained significantly higher content of moisture($p<0.05$), calcium, magnesium, copper and zinc, polyphenol and flavonoid content respectively. In mature silk, moisture protein, lipid level is lower where ash(5.51%),carbohydrate(29.74%) and total dietary fiber(52.2g/100g)is higher than immature silk. Therefore by the use of ethanol extract the immature and mature possess strong free radical scavenging capacity. The ethanol extract of immature silk had highest antiuodiant capacity. It is concluded that immature silk is more effective than mature silk.

The result of this study showed by Kilic*et al*.(2017) the antioxidant properties of some herbal teas(Green tea, Senna, corn silk, Rosemary) brewed at different temperatures (60ºc,80ºc,100ºc). The temperature at highest at 100ºc of the total phenolic content(4.872±0.005mg GAE/g) was determined in senna tea; the highest total flavonoid content range from (0.004±0.002 to 0.305±0.005 mg QE/g) and highest ferric reducing ability 670.150±2.121µmol Feso4 7H20/g, the highest condensed tannin content in green tea (9.443±0.524 mgCE/g). The result shows that plant species solvent types, boiling temperature can affect the total phenolic content, total flavonoid tannin content and ferric reducing antioxidant activity,

Nessa*et al*.(2012) stated the antimicrobial activities of extracts and flavonoid glycosides of corn silk(*Zea may*). The petroleum ether(PECS), chloroform (CECS) and methanol (MECS) extracts (25mg/ml), two isolated flavonoid glycoside (2.0mg/ml) of corn silk were tested for their antimicrobial activity. The results of antimicrobial activity of extract shows petroleum ether and methanol extract were sensitive against eleven bacteria out of twelve bacteria chloroform was sensitive only against five bacteria. Therefore the extract of corn silk can protect the body from different disease condition related to the pathogenic organisms.

Todhanakasem,*et al. (*2015**)**conducted a study on the development of corn silk as biocarrier of *Zymomonasmobilis* biofilms in ethanol production from rice straw, it is found that delignified corn silk acts as a potential biocarrier for *Z.mobilis* biofilm formation resulting in significant ethanol yields from rice straw hydrolysate.

Milind*et al*.(2013) observed that *Zea mays* a modern craze it have been narrated miscellaneous uses of corn varieties like medicinal uses of corn varieties like medicinal uses, industrial uses, culinary uses, pharmacological uses and corn dishes. Hence corn silk extract done to determine effect of dieresis, hypoglycemic ant fatigue, nephrotoxicity, anti-inflammatory and antioxidanttherefore maize has become a craze among modern youth.

Anilakumar*et al*.(2017) states that advances in the value addition to foods and the role of emerging food processing technologies for value addition and their significant effects on storage and preservation. The results shows that new packaging technologies and by products of fruits and vegetables should be processed at safer

limits and quality standards. Now a days there is aware of diet and lifestyle related health problems that demands safe food for human consumption.

Studies of Okunade*et al*.(2015) on the effect of aqueous corn silk *(Zea mays)*the showed that corn silk extract may be useful tool of considerable therapeutic importance in lowering blood pressure due to its sodium lowering and its potassium sparing properties.

Bigliardi*et al*.(2010) explained that successful new product development in the food packaging industry, it focuses on the development of new product, the industry recently launched on market in response to needs of packaging liquid, viscous or creamy foods. Therefore the results shows that highlighting the strengthens and weaknesses of the new product development process undertaken by the food industry (i.e from the idea of the new product to launch on the market and patent and at same time, it provides useful guidelines for new product development processes in food packaging industry.

Mehboob*et al*.(2014)conducted a study on effect of corn silk extract on acetaminophen induced renal damage in mice. The result have been revealed that single dose of 600mg/kg body weight of acetaminophen to mice resulted in tubular necrosis, cast formation, inflammation and congestion which disappeared upon treating the mice with corn silk extract with dose of 400mg/kg body weight indicating that corn silk protects renal injury induced by acetaminophen and finally it has significant impact on future clinical treatment of patients with renal malfunction.

Catap*et al*. (2015) investigated the use of corn silk as protective capacity in aquaculture like nile tilapia, orrochromisniloticus. The result have been shown that potential of corn silk as potent antioxidant in cultured fish species and therefore further immune based trials are needed to maximize fully the protective property of corn silk against fish pathogens.

Corn silk extract was applied to the human face with hyperpigmentation and skin colour was measured to examine the degree of skin pigment reduction. The results have been shown that the application of corn silk extract 0.75% and 1.5% solutions twice day for 8 weeks and it is deemed to have high potential as a skin whitening material (Choi *et al*., 2014).

This review shows the corn silk induces nitric oxide synthase in murine macropahges and results have been showed that it activates murine macrophages to induce nitric oxide synthase (NOS) and generate substantial amounts of nitric oxide in time at concentration range of 2.5-7.0 µg/ml (Kim*et al*., 2004).

The study on formulation and nutritional evaluation of a healthy vegetable soup powder supplemented with soy flour, mushroom and moringa leaf by Farzana,*et al*.(2016) showed that among the locally available soup powder where soy – mushroom-moringa soup powder has higher shelf life and it can be acceptable upto6 month and it is specifically high in protein, ash, fiber, vitamin D, vitamin C and other minerals.

Aires *et al*. (2016) stated the polyphenol composition and antioxidant activity of corn silk hairs using ultrasound extraction method. The results have been shown that the method used to identify and quantity polyphenols in corn silk hairs is accurate and feasible and ultrasound extraction is very useful method to maximize the amount of polyphenols extracted. The component in polyphenols is chlorogenic acid is 42.4±0.7µg-g^{-1} dw^{-1}, caffeic acid is 13.7±0.5µg $g^{-1}dw^{-1}$,ferulic acid 48.1±0.6µg-g^{-1} dw^{-1},apigenin 7.9±0.6µg-g^{-1} dw^{-1},pelargonidin 2.6±0.1µg-g^{-1} dw^{-1} thus this plant materials highly valuable to be used as natural source of polyphenols and may contribute to its industrial applications for nutraceutical products development.

Eltohami*et al*. (2013) undertaken the study on the hypoglycemic and hypolipidemic effect of methanol extract of corn silk (*Zea mays*) in streptozotocin-induced diabetic rats. The results have shown that streptozotocin diabetic rats both doses(200mg/kg and 400mg/kg) of extract reduced blood glucose in addition to blood urea ($p<0.05$) and significant cholesterol lowering effect ($p<0.001$).

Eman*et al*. (2011) stated that antioxidant and antibacterial activities of Egyptian *Maydis stigma* (zea mays hairs) rich in bioactive constituents, therefore the results examined that upper parts and lower parts of corn silk revealed there were non significant variation between upper (2.735±1.180 mg/g GAE^s) and lower parts (2.150±1.180mg/g GAE^s) of the corn silk. The upper parts were found to have highest total antioxidant capacity and DPPH scavenging activity (2.735±1.180mg/g GAE^s)

Bisen*et al*. (2017) The standardization of recipes and accepatability of value added products of anola(*Emblicaofficinalisgaertn*)pulp, projected that mixing of Anola and guava pulp in the ratio of 40:60 with 500g sugar was found best during storage period of 100days. It is found that both fruits are suitable for preparation of mixed fruit leather with good quality and high nutritive value.

Ismael,*et al*.(2017) observed that detection of rutin, kaepferol and quercetin based crude from corn silk and studying their effects on the inhibition of pure urease enzyme and urease of klebisella species. Therefore the results have been showed that three flavonoids (Rutin,Kaemferol and Quercetin) concerning flavonoids constitution of corn silk extracts were (0.012mg/l) of Quercetin in 99percent ethanolic extract,(0.13,0.15,0.11 mg/l) of (Rutin,Kaemferol and Quercetin) respectively in 80 percent ethanolic extract. Therefore 80percent gives better and higher concentration and inhibition of pure enzyme exhibited (IC50=402.8,95.8,348 mg/l) for 99percent ethanol,80percent ethanol and aqueous extract(IC50=54077mg/l) in thiourea.

Haslina*et al*. (2017) observed that local corn silk powder of three different varieties of corn silk had different amounts for their moisture, ash, protein, fat and carbohydrate content from the proximate analyses. Thus it may be suggested that among three local varieties of corn silk, a corn silk powder from Bisma variety could be developed as a source of bioactive compounds and nutrients to convert corn silk being waste into value added corn products.

Studies of Adedapo*et al*. (2016) showed that the aqueous extract of corn silk is safe for use medicinally because the 3200mg/kg, the highest dose did not produce any lethal change in mice therefore animal appears normal and no morality was recorded.

The results of research work of Ren*et al*. (2013) on antioxidant activity of five flavones glycosides from corn silk explored that scavenging capacity increased in concentration in compoundIV-6,4dihydroxy-3-methoxyflavone-7-O-glucoside.(IC50=2.7µg/ml). So this flavonoid could be beneficial natural food antioxidant.

The studies by Joy *et al*. (2012)revealed the medicinal value of *Cassia auriculatalinn*, is noted that number of phyto constituents have various therapeutic

purposes. The plant or its individual parts can be used for the treatment of various disorders in human such as diabetes, liver, toxicity, and fungal infection.

Guo*et al*. (2009) stated that corn silk extract treatment markedly reduced hyperglycemia in alloxan induced diabetic mices. The action of corn silk extract on glycaemic metabolism is not via increasing glycogen and inhibiting gluconeogenesis but through increasing insulin level as well as recovering the injured β-cells.

Aukkanit*et al*. (2015) observed the utilization of corn silk in low fat meatballs and its characteristics. The results shows that increasing of corn silk powder in meat balls have higher ash and fiber it increases juiciness(5.39%) and shrinkage (6%) and the texture quality of meat balls are increased at the percentage.

The result of the study carried out by Ashok,*et al*. (2015) on Comparative assessment of antioxidant potential of *Cassia auriculata Linn* flower, implied that these plant parts especially flowers can be served as natural sources of antioxidant and could be used in treatment of diseases that have free radical origin and as a substitute for synthetic drugs.

Aparna,*et al*.(2015) studied the phytochemical investigation, optical characterization and anti-diabetics studies of *Sennaauriculata*(Avaram poo). The result have been shown that anti-diabetic capability of *Sennaauriculata* flower extract was measured using DNS(3,5-Dinitrosalicylic acid) assay and found to exhibit significant activity against diabetic disorder.

Kaur*et al*. (2015) stated that potential applications of corn silk in phytochemical and pharmacological fields. The results shows that corn have potential therapeutic applications of corn silk. In vitro and in vivo studies are conducted showing remarkable bioactivities of corn silk in various diseases. Toxicological findings showed safety and non toxic nature for human consumption.

Amue*et al*. (2012) conducted a study on new product development and consumer innovative behavior, the results have given that significant relationship exists between new product development and consumer innovative behaviour and it concludes that electronic home appliance companies should always take into cognizance consumer personality and perception impacts more significantly on new product development.

Kashamar*et al.*(2018) undertaken a clinical study of three medicinal plants (*Foeniculumvulgare, Zea mays and Petroselinumsativum*) against urinary tract infection and stones. The results has shown that clinical study has strong effect in treatment of urinary tract infection and stones more than individuals extracts. The combination of the antioxidantive stress and antibacterial activity of these three medicinal plants related to mechanism of treatment of UTT and kidney stones.

The studies revealed by Sukandar,*et al*. (2013) that both silk of corn (*Zeamays.L*) and binahong(*Anrederacordifolia (ten) steenis*) leaves extract could improve kidney function in rat model of kidney failure. Combination of half dose of each extract showed effects comparable or slightly better than an individual extract showing to have at least additive effect. Reduction of oxidative stress provided by each extracts and their combination might be correlated with mechanism of repairing kidney failure.

III METHODOLOGY

The steps involved in undertaking the present study entitled, "**Development of Value Added Herbal Products by Incorporating Corn Silk",**consist of following:

A. Selection of area
B. Collection of Corn silk
C. Preparation of Corn silk powder
D. Analysis of nutrients
E. Shelf life of the corn silk powder and developed product
F. Development of herbal products
G. Acceptability studies
H. Analysis of nutrient content of developed product
I. Statistical analysis

A. Selection of Area

The area selected for the present study is Coimbatore owing to its easy accessibility, approach and convenience. The convenience sampling method was followed to select Coimbatore city. When the population elements are selected for inclusion in the sample based on the ease of access, it can be called convenience sampling (Kothari, 2018). The present study is approved by institutional human ethics committee (Annexure I).

B. Collection of Corn Silk

Corn (Zea mays Linnaeus), also known as maize, is a member of the family Poaceae or Gramineae. All parts of corn are utilized, including the silks. The colors of the CS, at first are usually light green and later turn into red, yellow or light brown(Hasanudin, 2012).corn silk is waste product from field corn is selected for the present study it has health benefits. Among different varieties of corn (Sweet corn, field corn, baby corn, field corn is selected to get corn silk, after 4 months later, corn silk is completely dried and it is collected from harvested area. Natural manure as cow dung is used for the field corn cultivation. Thereforeone kilogram of corn silk was collected and dried by sun dry method and hot air oven method to identify the effective drying method.

Plate 1: Corn Silk

C. Preparation of Corn Silk Powder

Corn silk powder is developed under two different methods such as sun dry method and hot air oven method to determine the effective technique to develop the product. Sun dry method is one of the oldest method to preserve food. The main purpose to use this method it lowers the water content and reduces the food spoilage by micro organism(NaseerAhmed,2013).Corn silk is washed by using distilled water nearly 2 to 3 times ,the water is drained by squeezing the corn silk and spread on cotton cloth in open sun exposure. Silk was dried in sunlight for two days until it is dried completely. If any dust particles in the silk, due to wind blowing it is removed. Finally corn silk is powdered and it is sieved for three times to get fine powder and powder is stored in the air tight container.

Plate 2: Sun Drying of Corn Silk

Plate 3: Sieving Corn Silk Powder

The hot air oven method is used to reduce the moisture when air passes over food products, the heat transfer to surface and inner parts of the food products. Corn silk is washed in distilled water and squeezed it, and dried in an oven at 105ºc for six hours (Mazandarani, 2014**).** The physical and mechanical methods namely sun drying and hot air oven methods are used to develop the corn silk powder and determined the best effective method to develop the product.

D. Analysis of nutrients

Studies have been showed that corn silk is excellent source of many bioactive compounds like minerals such as calcium,potassium,magnesium and manganese and zinc (Wan *et al.,* 2010). In this study, field corn is collected to find out the major and minor nutrients, total antioxidant capacity and toxicity.The nutrients composition such as present in the dried corn silk powder is determined by following the standard procedures.

I. Moisture

Weighed five gms of sample in a stainless steel dish. Dried it in an oven for 4-5 hrs at 1050 C + 50 C, cooled the dish in a desiccator and then weighed the dried sample (I.S.I Handbook of Food Analysis, 1984).

II. Total ash content

Weighed fivegms of sample in a porcelain dish. Ignite the material in the dish with flame of suitable burner. Complete the ignition in a muffle furnace at 600 + 200 C for 4 – 5 hrs. Cooled in a dessicator and weigh.(I.S.I Handbook of Food Analysis, 1984).

III. Total protein

The protein content is determined from the organic Nitrogen content by followingKjeldahl method. The calculation of protein as N x 6.25. Protein on dry weight basis=protein content x100**.** (Pearsons Composition and Analysis of Foods, 1991)

IV. Potassium

In 100 ml standard flask,preparedPotassium standards (*NIST traceable*) to 0.5,1,2,3,4 and 5mg in distilled water from 1000 ppm solution. Prepared a blank solution in 100ml distilled water. Then 100ml of digested sample in a beaker and

followed the work instruction for the operation of Atomic AbsorptionSpectrophotometer (AAS**)**. Aspirate the blank, standards and sample solution and finally measure the absorbance of the Potassium at 766.5 nm(AOAC 2009).

V. Calcium

The sample was ashed in a muffle furnace at 550°C until the whitish or grayish ash was obtained. The ash was treated with concentrated hydrochloric acid, transferred to a volumetric flask and made upto 100 ml. Take 100ml in conical flask. And add 2-3 drops of sodium hydroxide 1N solution (4.1) and to raise the pH 12 - 13.Add a pinch of Patton &Reeder (4.3) indicator and stir well. It is titrated against the solution with 0.01M EDTA (4.4). The end point is appearance of blue colour (AOAC 2009).

VI. Phosphorous

Boiled the ash with10 ml of 5 M HCl and wash the solution into a 100 ml flask with water, filtering if necessary. Neutralize by drop wise addition of 0.88 ammonia (volume of the solution at this stage should be 50-60ml). Make just acid with dilute nitric acid, add 25ml of vanadate – molybdate solution, make up to mark and measure optical density after allowing to stand for 10 minutes**.** (Pearson's Composition and analysis of foods, 1991)

VII. Sodium

Prepared Sodium standards (*NIST traceable*) to 0.5,1,2,3,4 and 5mg in distilled water from 1000 ppm solution and blank solution in 100ml distilled water is taken. Then took a 100ml of sample in a beaker and followed the work instruction of Atomic Absorption Spectrophotometer (AAS). Aspirated the blank, standards and sample solution. Measured the absorbance of the Sodium (AOAC 2009).

VIII. Manganese

Added 500 to 600ml of distilled water into the flask, 0.1g of potassium permanganate previously dissolved in 5ml of water and a few drops of dilute sulphuric acid. Distilled carefully taking care that there is no carryover by splashing or otherwise of liquid from the flask, and rejected the first 50ml of distillate (AOAC 2009).

IX. Total dietary fiber

This method is the simplified modification of the AACC total dietary fiber (TDF) method, 32-05, and the AACC soluble/insoluble dietary fiber method (for oat products), 32-21(Megazyme International Ireland Limited, 2005).

X. β Carotene

The sample was blended with 8 g anhydrous sodium carbonate and mixed with a mechanical blender. Ten grams of the mixture was transferred into a centrifuge tube, added with 20ml Tetrahydrofuran (THF) and mixed for 2 min under cold water. The mixture was centrifuge at 5000 g for 5 min and the supernatant was collected. Extraction was performed by adding 15 ml dichloromethane (DCM) and 15 ml of 10% w/v NaCl into the supernatant and shaken for 2 min. The extraction was repeated twice, organic layer was collected and evaporated under nitrogen steam(AOAC 2009).

XI. Total bacterial count and total fungal count

After the preparation of test sample two sterile petri dishes using a sterile pipette, transfer to each dish 1 ml of the test sample and pipette out 1 ml each of the sample and 1 ml each of suitable dilutions into the duplicate petriplates and pour 10-15 ml of agar medium(cooled to 45º -50º c) and rotate the Petri dishes clockwise and anti clockwise for uniform distribution of the inoculums and allow to Solidify. The result shows that TBC 1 g of sample at 30°c is expressed in CFU.

To find out the total fungal growth the procedure is similar as bacterial count after preparing the test sample and it is transferred to petri dishes therefore suitable solution is added and pour Dextrose Agar and incubated at 30 c.Various bacteria grow on this medium some molds and yeasts also grow on Trypticase Soy Agar. Finally the result shows that TFC 1 g of sample at 30°c is expressed in CFU(AOAC 2009).

XII. Vitamin C

Pipetted out 50 ml of unconcentrated juice (or the equivalent of concentrated juice) into a 100 ml volumetric flask, add 25 ml of 20 percentmetaphosphoric acid as stabilizing agent and dilute to volume. Pipette 10 ml in a small flask and add 2.5 ml acetone. Titrate with indophenol solution until a faint pink colour persists for 15 seconds (Pearson's Composition and Analysis of Foods, 1991).

XIII. Vitamin B12

Determination of vitamin B_{12} in foods and vitamin premixes using aqueous extraction, immunoaffinity clean-up / concentration and HPLC were evaluated and assessed in this study. The combination of HPLC or UPLC and sample preparation using immune affinity media offers a rapid means of determining vitamin B_{12} in foods and should improve the analytical uncertainty of the measurement compared to the microbiological assay procedures currently used.(PaulLawrance , An Evaluation of Procedures for the Determination of Vitamin B_{12}in Foods, Supplements and Premixes using HPLC and UPLC after selective extraction with immunoaffinity cartridges. A Government Chemist Programme Report Number,2011).

XIV. Texture analysis

Force is applied on the product similar to the process of chewing or bitingand the response of the product to the force applied is measured.. Fixing the Three point bending jig to measure the hardness/ brittleness of theproduct.Select the method of analysis to be done. Thenset stroke to 5mm / sec and enter the dimensions, namely the length, breadth and thickness of the foodsample.Set the settings for display of results , force and stroke to zero. Finally place the food sample and start the test.The result is displayed as force in Newtons once the breaking point of the product is reached.

E. Shelf Life of the Corn Silk Powder And Product Developed Using Corn Silk

As the study focused on the value added food products it should be developed with qualitatively and food processing techniques to extend their shelf life of the product. Shelf life indicates that product should be acceptable for long period depends upon their nature therefore to enhance the shelf life the product should undergo various food processing techniques and methods to maintain the quality. As food processing technologies are introducing advanced methods in preservation of food and processing techniques and manipulates the existing products and also as a new products. In this study corn silk is been collected in dry form and it is formulated into powder and different products is been developed and the corn silk powder is incorporated at different proportions. Therefore further analyses is been carried to determine the shelf of the powder and developed products such as moisture content, microbial growth, fungal growth. Shelf life study is carried from the day of preparation 1 – 45 days then next 45^{th} day is been analysed for corn silk powder to

find out the microbial spoilage. Corn silk powder is stored in sterilized glass container. Glass is **nonporous and impermeable**, so there are no interactions between glass packaging and products to affect the flavor of productand it **zero rate of chemical interactions,** ensuring that the products inside a glass bottle keep their strength, aroma, and flavor.

Plate 4: Corn Silk Powder Stored in Glass Container

F. Development ofValue Added Herbal Products

Corn silk powder is prepared by 2 different methods like Sun dry method and Hot air oven method. Among from these methods finding out the acceptable level of nutritional composition of corn silk and further incorporating into products. Before introducing into the product, standardization of recipe was done thrice to find out the desirable quality of the product. The United States Department of Agriculture (USDA) defines a standardized recipe as that it should be adapted, and retried several times for use has been found to produce the same good results and yield every time when the exact procedures are used with the same type of equipment and the same quantity and quality of ingredients"(NSFMI 2002). In this study three different recipes like soup mix powder, tea powder and herbal biscuit were selected and standardized. The details of procedure for all the three recipes are shown in tables I,II,III,IV,V, and VI.

1. Development of Standard Soup Powder

The composition of the standard soup powder mix is given in the following table I.

Table I

Recipe for Standard Soup

Ingredients	Quantity (g)
Urdal dhal	30
Coriander seeds	5
Cumin seeds	20
Pepper corns	5
Dessiccated coconut	15
Cloves	3
Cinnamon	2
Curry leave	20

Method

1. Dry, roast all the ingredients in low flame and keep at room temperature until it becomes warm.
2. Grind it into fine powder and store it in zip lock polythene bag.

2. Variationsof Soup Powder

Soup powder is prepared at three different variations was shown in table II.

Table II

Formulation of Soup Powder Using Corn Silk Powder

Ingredients	Variation 1 (g)	Variation 2 (g)	Variation 3 (g)
Urdal dhal	30	25	25
Coriander seeds	10	13	10
Cumin seeds	15	20	20
Pepper corns	5	5	5
Desiccated coconut	15	15	15
Cloves	2	3	1
Cinnamon	2	2	1
Curry leave	20	15	20
Corn silk powder	1	2	3

Plate 5: Formulated Soup Using Corn Silk Powder

3. Development of Standard Tea Powder

The appropriate proportion of tea powder is given in Table III.

Table III

Recipe for Standard Tea

Ingredients	Quantity (g)
Avarampu	25
Coriander seeds	35
Sukku powder	25
Elachi	15

Method

1. Dry roast the coriander seeds and leave it aside and add elachi make into fine powder.
2. Then mix all ingredients together and store it in ziplock polythene bag.

4.Variations of Tea powder

Tea powder is prepared at three different variations is given below in Table IV.

Table IV

Formulation of Tea Powder Using Corn Silk Powder

Ingredients	Variation 1 (g)	Variation 2 (g)	Variation 3 (g)
Avarampu	25	25	25
Coriander seeds	35	33	35
Sukku powder	24	25	25
Elachi	15	15	12
Corn silk powder	1	2	3

Plate 6: Formulated Tea Using Corn Silk

5. Development of Standard Biscuit

Standard biscuit is prepared at correct quantity of the ingredients was shown in table V.

Table V

Recipe for Standard Biscuit

Ingredients	Quantity (g)
Whole wheat Flour	25
Refined wheat flour	10
Jaggery	10
Butter	50
Egg	5

Method

1. Sieve the flour to remove any dust particles and keep it aside
2. Take bowl add but butter add jaggery mix it well until it becomes creamy consistency
3. Beat the egg well and add gradually.
4. Add flour side by side and mix it well finely.
5. Make it into fine dough,then spread and knead the dough well.
6. Cut the dough with help of biscuit shaper.
7. Pre heat the oven at 180˚c for 10 minutes.
8. Spread butter in tray and bake at 120˚c for 15minutes.

6.Variation In Biscuits

Biscuits are prepared at three variations by using corn silk powder was shown in Table VI.

Table VI

Formulation of Biscuit Using Corn Silk Powder

Ingredients	Variation 1 (g)	Variation 2 (g)	Variation 3 (g)	Duration (min)	Temperature (℃)
Whole wheat Flour	10	15	10	15	120
Refined wheat flour	30	15	20		
Jaggery	15	15	15		
Butter	50	50	50		
Egg	4	3	2		
Corn silk powder	1	2	3		

Plate 7: Formulated Biscuit Using Corn Silk Powder

G. Acceptability Studies

In this study, the sample is tested under hedonic rating scale as shown in annexure II to measure the consumer acceptability of food products. From one to three sample are served to the untrained panelist at one session. The acceptability of the product on the scale, usually of 9 points ranging from 'like extremely' to 'dislike extremely'(Srilakshmi, 2012).

Plate 8: Sensory Evaluation by Untrained Panel Members

H. Analysis of Nutrient Content of Developed Product

The nutrient analysis is carried out for soup mix powder, tea powder, herbal biscuit. The best variations of three products is determined by using 9 point hedonic scale is noted and further the developed product is analysed for nutrient content of per 100g.

I. Statistical Analysis

The statistical test namely mean and t-test were analysed to find out the acceptability of value added products prepared with various level of variations.

IV RESULTS AND DISCUSSION

The results of the study entitled to the topic **"Development of Value Added Herbal Products by Incorporating Corn Silk",** are discussed under the following headings:

A. Sun dry method and hot air oven method

1. Nutritional composition of corn silk powder
2. Shelf life of the corn silk powder
3. Antioxidant assay of corn silk powder
4. Toxicity of corn silk powder

B. Sensory evaluation of formulated value added products using corn silk powder

C. Nutritional composition of developed value added products

D. Shelf Life of the Value Added products

E. Texture analysis of herbal biscuit

A. Sun Dry Method and Hot Air Oven Method

1. Nutritional Composition of Corn Silk Powder

Corn silk an unexploited food is dried by sun drying and hot air oven drying method and it is powdered. The nutritive value of corn silk powder, estimated by following standard procedure are shown in Table VII.

Table VII

Nutritional Composition of Corn Silk Powder Per 100g

Nutrients	Quantity	
	Sun dry method	Hot air oven method
Energy (Kcal)	190	163
Carbohydrate(g)	27	28
Protein(g)	12	11
Fat(g)	1	0.8
Dietary Fiber(g)	46	48
Ash(g)	6	0
Iron (mg)	0.3	0.4
Sodium(mg)	20	26
Potassium(mg)	2620	3250
Vitamin c(mg)	11	1
Vitamin b12(mg)	0.2	0
β carotene(µg)	669	0.012

The nutritional composition of corn silk powder dried by sun dry method per 100g had Energy 190kcal, Carbohydrate 27g, Protein 12g, Dietary fiber 46g, and

Vitamin C 11mg. With regard to vitamin C, β carotene and ash they were lower in the corn silk powder dried by hot air oven than in sun dried powder and differences were 10mg, 668µg and 6mg respectively. However it is noted that corn silk powder dried in hot air oven had high fiber as well as potassium content. Likewise, corn silk powder dried mechanically by hot air oven had carbohydrate, protein, fat and dietary fiber more or less similar except few nutrients compared to corn silk powder dried by sun dry method. It is obvious that in both the methods either by physically or mechanically dried corn silk powder there is not much difference in the nutritive value except potassium, vitamin C, β carotene and ash . But the potassium content was higher by 630mg in hot air oven method as against sun dry method.

2. Shelf Life of the Corn Silk Powder

The shelf life of the corn silk powder was observed for 45days. In order to understand the safety level of the corn silk powder, moisture, total bacterial count and fungal count were studied the details are presented in Table VIII.

Table VIII

Shelf Life of the Corn Silk Powder Dried by Sun Dry and Hot Air Oven Methods

Parameter	Level	
	Sun dry method	Hot air oven method
Moisture %	5.8	4.5
Total bacterial count (cfu/g)	$11*10^3$	$4.0*10^3$
Total fungal count (cfu/g)	Absent	Absent

The study shows that moisture content 5.8 percent ,total bacterial count is $11*10^3$cfu per 100g and absence of total fungal count are observed in the corn silk powder dried by sun drying method. In the case of corn silk powder dried by hot air oven moisture content is 4.5 percent,total bacterial count is $4.0*10^3$cfu, and total fungal count is zero. The research studies proved that maximum limit for moisture content in cereal and grains food products should not exceed more than 16 percent by weight. It is concluded that in both the methods moisture content within the desirable limits and total bacterial count is not more than 20000cfu/g and there is no fungal growth and hence these products are acceptable and safe for consumption(FAO 2010). The observation on shelf study revealed that the corn silk powder can be stored safely

for three months as there is no fungal growth and also the bacterial count was found to be within limited safety level and there was no fungal growth till 45 days of storage.

3. Antioxidant Assay of Corn Silk Powder

The total antioxidant assay of corn silk powder dried by sun drying and hot air oven method is shown in Table IX.

Table IX

Antioxidant Capacity

Method of Drying	Total Antioxidant Capacity (µg/g Ascorbic Acid)
Sun drying	53
Hot air oven	50

The total antioxidant capacity of corn silk by sun drying and hot air oven method are 53µg/g ascorbic acid, and 50µg/g ascorbic acid per100g respectively. The antioxidant plays a vital role in the way of protecting the body and cells from damaging free radicals and it prevents from other lifestyle disease condition. Therefore corn silk powder can be more acceptable as antioxidant property is above 50µg/g. since the antioxidant has curative and preventive effect it can be of useful as medicinal value.

4.Toxicity in Corn Silk Powder

In order to ensure whether there is any toxicity of heavy metals namely nickel and lead content the corn silk powder was analysed and the presence or absence of toxicity in corn silk powder is depicted in Table X.

Table X

Presence of Heavy Metals

Parameter	Level (mg/kg)	
	Sun dry	Hot air oven
Nickel	Not detected	Not detected
Lead	8.5	8.4

The toxicity analysis revealed that nickel is not present in the corn silk powder dried by both sun drying as well as hot air oven method. However the lead content

was 8.4 and 8.5mg/kg in corn silk dried by both methods respectively. The report of FAO (2010) stated that maximum toxicity level for cereals and grains like corn and corn related products food stuffs can be 50ppm(parts per million). The study proves that though the lead content was present it is found to be less than the maximum limit and it can be used.

B. Sensory Evaluation of Formulated Value Added Products Using Corn Silk Powder

Value added herbal products are developed by incorporating corn silk powder which increases more value to the product and provides necessary nutrients to enhances the health status of the individual. In this study development of three nutritional products like soup powder, tea powder and biscuit were using corn silk powder was developed. Recipes were prepared to find out the desired quality of the product therefore the value added products were prepared with various variations and standardized by incorporating the corn silk powder.

1. Standard Soup Mix Powder

In order to find out desired level of soup powder ,water, temperature and time required to prepare the acceptable standard soup three variations were undertaken and results are presented in table XI.

Table XI

Preparation of Standard Soup with Variations

Standard	Duration (minutes)	Water (ml)	Temperature (℃)	Addition of soup powder (g)
S1	10	100	105	1
S2	10	120		2
S3	15	130		3

It is noted that as the quantity of soup mix powder increasing proportionately the water and time required to attain the desired consistency of soup are progressively increasing where the temperature was kept at constant. When 2g of soup powder is added, the addition of 20ml of water was needed to prepare the soup. The time taken was found to be 10 minutes for 2g soup powder as well as the soup prepared 1g.

When 3g of soup powder is added, 30ml of water is needed while 15minutes was raised to attain the soup consistency when compared with the soup prepared by 1g soup powder.

2.Sensory Evaluation

The acceptability of soup prepared with three variations was judged by untrained panel members and the mean scores obtained for each attribute based on the hedonic scale are presented in table XII.

Table XII

Sensory Evaluation of Standard Soup

Standard	Appearance	Colour	Flavor	Taste	Consistency	Total mean
S1	7.90±1.03	7.80±0.76	7.80±1.1	7.90±0.99	7.76±1.19	39±5.07
S2	7.70±1.17	7.60±1.00	7.66±1.0	7.70±1.02	7.50±0.86	38±5.05
S3	7.40±1.24	7.26±1.20	7.46±1.07	7.50±1.10	7.50±1.16	37±5.77

The results shows that total mean is required to show highest value for acceptability, the standard 1 (100ml water +1g soup powder at 105ºC) has maximum score in which all the attribute appearance, colour,flavor, taste and consistency had the highest hedonic score ranging from 7.76±1.19 to 7.90±1.03 followed by this standard 2. The total mean score for three variations of standards are 39±5.07, 38±5.05, 37±5.77. The colour of S1 is light brown and brighter. Flavor and consistency of the soup powder retained till the temperature remains hot. The soup S1 was found to be more acceptable to prepare soup by incorporating corn silk powder.

3.Soup Incorporated With Corn Silk Powder

The highly accepted standard soup S1 was selected and three variations of soup incorporating 1,2,3g of corn silk powder was prepared and noted the water requirement ,duration to prepare soup at various level and the results are shown in Table XIII.

Table XIII

Preparation of Soup Using Corn Silk Powder

Variations	Appearance	Colour	Flavor	Taste	Consistency	Total mean	t value
V1	8.13±0.93	7.96±0.76	8.16±0.79	7.83±1.31	7.93±1.17	40±4.96	0.7722 ^{NS}
V2	7.26±1.14	6.66±1.37	6.56±1.56	6.73±1.41	6.90±1.39	34±6.87	3.2075*
V3	6.70±1.51	6.40±1.78	6.26±1.55	5.83±1.80	6.33±1.56	32±8.2	3.9769**

It is found that the quantity of soup powder increasing proportionately with the water requirement , time and temperature remains constant.

In variation V1 1g of soup powder and 1g of corn silk powder were added and prepared using 120ml of water to obtain a desirable consistency of soup. In variation 2 one g of soup powder, 2g of corn silk powder and 170ml of water were required to attain thin soup consistency. Further in variation 3 along with one g soup powder, and 3g of corn silk powder addition of 80ml of water was required when compared to variation 2. Hence it is observed as the quantity of corn silk powder is increased gradually the water requirement is also increases to get the desired quality of the soup.

4.Sensory Evaluation of Soup with Variations

Using hedonic scale, the acceptability test was carried out for the soup prepared with three variations. The mean scores fir selected attributes are depicted Table XIV.

Table XIV

Sensory Evaluation of Soup Using Corn Silk Powder

Variation	Duration (minutes)	Water (ml)	Temperature (℃)	Addition of Soup Powder+ Corn Silk Powder (g)
V1	10	120	110	1+1
V2	15	170		1+2
V3	15	250		1+3

Soup is prepared by incorporating corn silk powder to develop a value added products. The results show that variation 1 with addition of 1g of soup powder ,1g of corn silk powder and 120ml of water at 110ºC has the maximum score. It is obvious that the sensory attributes appearance, colour, flavor, taste, consistency had highest hedonic rating scale ranged from 7.83±1.31 to 8.16±0.79 for variation 1 and followed by variation 2 and 3. The flavor of the soup is very good and aroma of the corn silk powder retained in the soup. The taste was good and there was no bitterness in thin soup because only 1g level of corn silk powder was added. The appearance and colour looked bright and found to be highly acceptable.

The total mean score for variation 1 was 40±4.96,34±6.87,32±8.2.Thus it shows that variation 1 is found to be highly acceptable in terms of all stated attributes. It is found that there was a significant difference in sensory evaluation of standard 1 soup with variation 2 and 3.

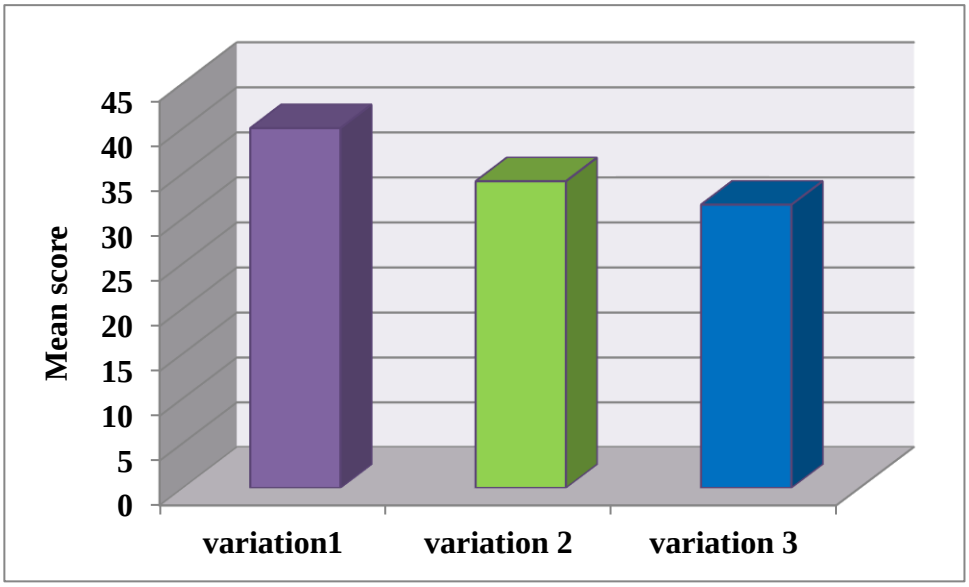

Figure1: Soup Mix Powder

bIt is obvious from the figure that the acceptability score was maximum for the variation 1.

5.Tea Powder

In order to find out desired level of water, temperature and time required to prepare the acceptable tea powder three variations were prepared and results are presented in Table XV.

Table XV

Preparation of Standard Tea

Standard	Duration (minute)	Water (ml)	Temperature (ºC)	Addition of Tea Powder (g)
S1	5	120	103	1
S2	10	150		2
S3	10	200		3

It is observed as the quantity of tea powder is increasing proportionately the water requirement and time is also elevated to attain the light tea. When 2g of tea powder is added the addition of 30ml of water is required and time taken is 10 minutes than the variation 1 and 3g tea powder is added with addition of 50ml is required as against the standard 2. Therefore the water requirement and time is gradually increases to get the desirable light tea.

6.Sensory Evaluation of Standard Tea

The result of the acceptability test undertaken to identify the best standard tea are portrayed in table XVI.

Table XVI

Sensory Evaluation of Standard Tea

Standard	Appearance	Colour	Flavor	Taste	Total mean
S1	6.9±1.2	6.9±1.2	6.8±1.3	6.8±1.5	27.4±5.2
S2	7.1±1.1	7.1±1.2	6.9±1.4	6.8±1.3	28±5
S3	6.6±1.4	6.8±1.2	6.6±1.1	6.5±1.3	27±5

The standard tea is prepared to find out the desired quality of strong, medium or light tea. The highest rating scale is scored in standard 2 with addition of 2g of tea powder with 150ml of water and prepared at 103ºC has the maximum score in which all the attributes of appearance, colour, flavor, taste had the highest hedonic score ranging from 6.8±1.3 to 7.1±1.2 followed by standard 1. The quality of the tea is light, flavor and taste were good and colour was light yellowish.

7.Preparation of Tea Incorporated With Corn Silk Powder

To determine the desired quality of tea using corn silk powder the level of water and time is required was noted for three variations and the results are shown in Table XVII.

Table XVII

Preparation of Tea Using Corn Silk Powder

Variation	Duration (minute)	Water (ml)	Temperature (˚c)	Addition of Tea Powder+Corn Silk Powder (g)
V1	10	200	110	2 + 1
V2	10	230		2 + 2
V3	15	270		2 + 3

With these combination the requirement of water and the time taken for the preparation of tea was noted. Since standard 2 was identified as highly acceptable along with 2g tea powder 1,2,3 g of corn silk powder was added in three variations. In variation 2, 2g of tea powder and 2g of corn silk powder with addition of 30ml of water is required compared to variation 1 and the time required was 10min. when light tea is preferred minimum quantity of tea powder and more quantity of water is required.

8.Acceptability Test for Tea

The result of acceptability test for tea prepared using corn silk powder is showcased in Table XVIII.

Table XVIII

Sensory Evaluation of TeaUsing Corn Silk Powder

Variations	Appearance	Colour	Flavor	Taste	Total mean	t value
V1	7.7±0.7	7.6±1.0	7.2±1.1	7.4±1.9	30±4.7	1.5963 NS
V2	7.6±1.6	7.5±1.4	7.4±1.4	7.2±1.7	28±6.1	0
V3	6.5±1.4	6.2±1.8	5.7±1.8	5.2±2.0	24±7	2.5469*

The results show that variation 1 with addition of 2g of tea powder and 1g of corn silk powder with addition of 200ml of water at 110ºC was highly acceptable since it has highest mean scores and all the attributes of appearance, colour, flavor, and taste scored higher than the rest of variations. The variation 2 had good appearance, desirable colour, flavor and taste. However, standard 2 tea is paried with variation 3 it is found that there is significant difference in sensory evaluation done for tea.

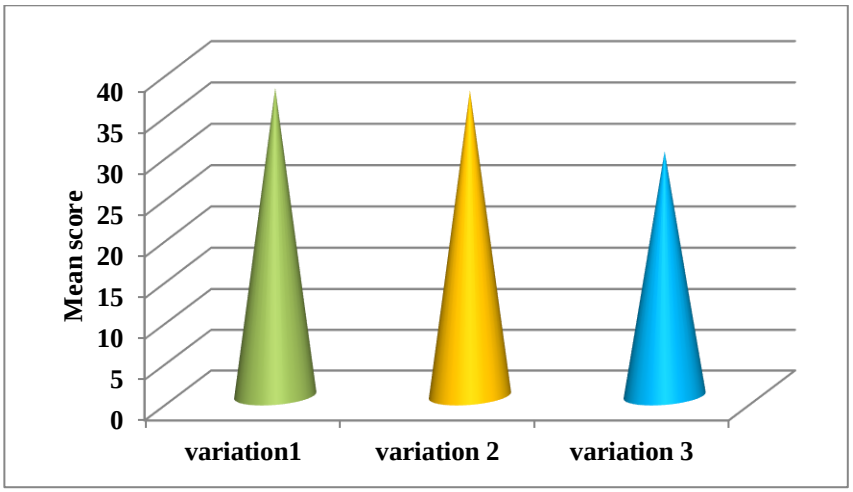

Figure 2: Tea Powder

It is clear from the figure that the acceptability score was maximum for the variation 1 for tea powder incorporated corn silk as 2g of tea powder and 1g of corn silk powder with addition of 200ml of water at 110ºc.

9. Standard Biscuit

In order to find out desired quality of biscuit three variations of standards were undertaken and the results are presented in Table XIX.

Table XIX

Preparation of Standard Biscuit

Ingredients	**S1 (g)**	**S2 (g)**	**S3 (g)**	**Duration (min)**	**Temperature (℃)**
Whole wheat Flour	20	15	10	15	120
Refined wheat flour	10	15	20		
Jaggery	15	15	15		
Butter	50	50	50		
Egg	5	5	5		

It is stated that to get desired quality of biscuit the major ingredients like whole wheat flour and refined wheat flour are added at different proportions and the time and temperature remains constant. The ingredients like jaggery, butter and egg remained constant. The total of cereal flour mix was kept constant as 30g. The time and temperature was similar for all the three preparations of tea.

10.Acceptability Test for Standard Biscuit

Table XX projects the results of the sensory evaluation for various attributes for identifying the most acceptable standard preparation of biscuit.

Table XX

Sensory Evaluation of Standard Biscuit

Standard	Appearance	Colour	Flavor	Taste	Texture	Total mean
S1	6.5±1.4	5.9±1.6	7.2±1.6	7.1±1.5	6.1±1.4	33±7.5
S2	5.9±1.7	5.3±1.8	6.6±1.7	7.1±1.4	6.3±1.7	31±8.3
S3	6.9±0.9	6.8±1.3	7.3±1.2	7.4±1.2	5.5±1.7	34±6.3

The total mean is calculated to find out the best product and it is mentioned in the table. The results show that standard 3 has the highest score in which all the attributes of appearance, colour, flavor, taste and texture. And the highest hedonic score ranges from 5.5±1.7 to 7.4±1.2 followed by standard 1. The appearance looks good good it does not over baked and burned, the colour looks lite ash colour, flavor and taste is very good and the texture of the biscuit is good.

11.Biscuits Incorporated with Corn Silk Powder

To examine the desired quality of the biscuit using corn silk powder three variations are developed and the results are shown in table XXI

Table XXI

Preparation of Biscuit Using Corn Silk Powder

Ingredients	Variation 1 (g)	Variation 2 (g)	Variation 3 (g)	Duration (minutes)	Temperature (°c)
Whole wheat Flour	10	10	10	15	120
Refined wheat flour	20	20	20		
Jaggery	15	15	15		
Butter	50	50	50		
Egg	4	3	2		
Corn silk powder	1	2	3		

It is noted that the biscuit is obtained by incorporating corn silk powder at different proportions. The quantity of the egg is reduced and the other ingredients

remains same with the addition of increasing corn silk powder at gradually where time and temperature kept constant.

12.Acceptability Test for Biscuits Prepared by Incorporating Corn Silk Powder

The result shows that biscuits in variations have shown inTable XXII.

Table XXII

Sensory Evaluation of Biscuit Using Corn Silk Powder

Variation	Appearance	Colour	Flavor	Taste	Texture	Total mean	t value
V1	7.9±0.9	7.6±0.8	7.8±0.8	7.7±1.0	7.0±1.4	38±4.9	2.7451*
V2	7.7±1.0	7.5±1.0	7.2±0.8	6.9±1.2	6.6±1.2	36±5.2	1.3410^{NS}
V3	7.7±1.1	7.5±0.8	6.8±1.0	6.3±1.7	5.7±1.6	34±6.2	0

Total mean is required to show the variation in table. The result shows that variation 1 has the highest score among the other two variations in all the attributes of appearance, colour, flavor, taste and texture had the highest hedonic score ranging from 7.0±1.4 to 7.9±0.9 followed by variation 2.

The total mean for three variations are 38±4.9,36±5.2,34±6.2 thus it reveals that the variation 1 is found to be highly acceptable in terms of all stated attributes. The t value shows that variation 1 is significant when it is paired with standard 3. The appearance looks good and it is not over baked, colour looks good and light brown colour was observed due to addition of jaggery and corn silk powder, flavor was delight, taste was good and texture of the biscuit enhances by addition of 1g corn silk powder shows that gives the excellent texture to the product.

The low fat meat balls incorporated with the corn silk at different level 0 percent, one percent, two percent, three percent, four percent was prepared. It is revealed that adding 1g of corn silk powder enhanced juiciness and shrinkage. The color of meatballs with corn silk powder had more redness. Texture properties of meatballs, shows that there is no difference in hardness, springiness and adhesiveness from the control but their cohesiveness, gumminess and chewiness are increased. The sensory score did not show any difference from the control in all attributes. The present study shows that addition of 1g corn silk powder in herbal biscuit scored 7.9±0.9 for appearance , 7.6±0.8 for colour, 7.8±0.8 for flavor , 7.7±1.0 for taste,

7.0±1.4 for texture. Variation 1 is best among the other variations of biscuit with the addition of 2g and 3g of corn silk powder. The present results of this study co relates with the study on utilization of corn silk in low fat meatballs and its characteristics as observed by Aukkanit et al. (2015).

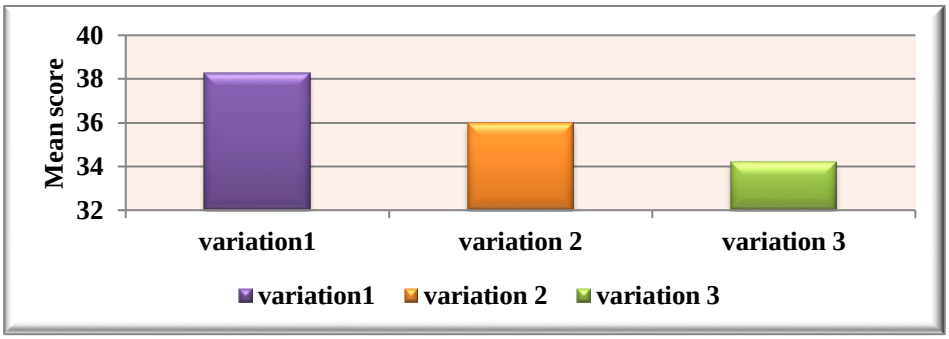

Figure 3: Herbal Biscuit

The figure shows that the maximum score is observed in variation 1where 1g of corn silk powder is used and it enhances the quality of the biscuit.

C.NutritionalComposition of Developed Value Added Products

The nutritional composition of value added products per 100g are mentioned in Table XXIII.

Table XXIII

Nutrient Content of Value Added Products

S.no	Nutrients per 100g	Value added products		
		Soup mix	Tea powder	Herbal biscuit
1	Energy (kcal)	315	61	432
2	Carbohydrate (g)	54	10	58
3	Protein (g)	12	5	9
4	Fat (g)	6	0.25	18
5	Dietary Fiber (g)	8	15	7
6	Ash (g)	3	3	3
7	Iron (mg)	0.2	0.08	4
8	Sodium (mg)	540	10	280
9	Potassium (mg)	1200	1108	320
10	Vitamin c (mg)	0.18	0.16	1.2
11	Vitamin b12 (mg)	0.01	0.009	0.05
12	β carotene(µg)	0.008	0.003	0.034

Among the three variations in soup mix V1(1:1-1g soup powder and 1g corn silk powder),V2(1:2- 1g soup powder and 2g of corn silk powder),V3(1:3- 1g soup powder and 3g corn silk powder) variation 1 scored high by sensory evaluation. So the nutritional composition of variation 1 for the soup mix is analysed the major nutrients composition of energy315kcal, carbohydrate 54g, protein 12g, fat 6g, dietary fiber 8g and it is found that soup mix powder is rich source of protein, dietary fiber, sodium 540mg ,potassium 1200mg and the major nutrients as dietary fiber and protein is high due to addition of corn silk it enhances nutritional value to the soup mix. With regard to tea the best was found to be variation 1. As far as tea is consumed it is rich source of dietary fiber 15g. This may helps to reduce the inflammation and eliminates the toxic in our body. Finally the herbal biscuit variation found to be the best desired quality. It is rich in protein 9g because of egg and corn silk powder , iron 4g and fat content 18g butter increases the level of fat. Therefore the results implies that by the addition of corn silk powder it increases the nutritional value to the biscuit and provides adequate amount of nutrients to the individual. It is much helpful in underweight persons to gain weight as it is rich in protein and fat

D. Shelf Life of the Value Added Products

The shelf life of the powder was observed for the value added products to understand the safety level in terms of moisture, bacterial count and fungal count and they are presented in Table XXIV.

Table XXIV

Shelf Life of the Developed Products

Parameter	Soup Powder	Tea Powder	Herbal Biscuit
Moisture %	4.2	7.0	5.8
Total bacterial count (cfu/g)	$2.0*10^2$	$1.8*10^2$	$2.0*10^2$
Total fungal count (cfu/g)	Absent	Absent	Absent

The study shows that moisture content was 4.2, 7.0 and 5.8 percent in value added products Soup powder, tea powder and herbal biscuit respectively. Total bacterial count shows that $2.0*10^2$, $1.8*10^2$ and $2.0*10^2$ and total fungal count was absent in all the three value added products. The research states that maximum limit for moisture content in cereal and other grains food products should not exceed more than 16 percent by weight. It is concluded that moisture content was found to be desirable limits in developed value added products and total bacterial count is not more than 20000cfu/g and there is no fungal growth and hence these value added herbal products are acceptable and safe for consumption.

E. Texture Analysis of Herbal Biscuit

It is observed the texture quality for the biscuit and the results are shown in table XXV

Table XXV

Texture Analysis

Name of the product	Parameter	Hardness of Force (N)	Organoleptic
Standard (Herbal biscuit)	Average	48.5172	18.06667
Variation1 (Herbal biscuit)	Average	52.7210	19.36667

The texture analysis is done to determine the force that is required to bite the biscuit and here for the standard biscuit average force 48.5172N is required and by the addition of corn silk in biscuit variation1 the average force was 52.7210 N. More or less both the standard and variation 1 biscuit had least difference in hardness of force. The variation 1 biscuit was identified as the best among the three variations. Hence the texture analysis was done for this variation 1. It is noted that there is a difference in the average force required to bite the standard biscuit and Variation 1 biscuit. From the sensory evaluation it is observed that there is no much variation for

the texture attribute of biscuits between standard and variation 1.Hence it can be stated that there is no difference in the acceptability of biscuit for standard and biscuit with variation 1.

V. SUMMARY AND CONCLUSION

Corn commonly known as maize (*Zea mays L*.,) is annual crop belongs to grass family Graminae. The word Zea mays orginates from ancient greek, *Zea*means sustaining life – *mays* come from language Taino meaning life giver. Corn silk is considered as the waste by product of maize (corn) and it is also one of the essential cereal and edible grains.Silk thread length is 30 cm depends upon the type of corn varieties.Corn silk powder is processed and causes some changes in their chemical characteristics depends upon the variety of corn silk. The changes takes place due to different processing techniques to prepare corn silk powder. Drying is the one of the most effective method to dry the products where it eliminates the moisture and therefore it extends the shelf life of the powder.

Corn silk is excellent source of many bioactive compounds such as volatile oils, steroids and other natural antioxidant such as flavonoids and other phenol compounds and which is more beneficial to human health and it acts as preventive measures .Corn and the other parts are used in various food preparations, agricultural and medicinal. It contains some minerals such as Calcium, Magnesium and Phosphorus were present at 95, 345 and 398.62 mg/100g respectively It has moisture content of 9.65 per cent, 17.6 per cent protein, 0.29 per cent fat, 3.19 per cent ash and 40 per cent dietary fiber. It is an attempt to create novel food products by value addition with corn silk powder and to analyse the nutritional composition and shelf life of the product to be essential for the healthy life.

The board objective of Development of Value Added Herbal Products and assess its acceptability and nutrients content. However , the specific objective of the study shows preparing corn silk powder by two methods like sun dry method and hot air oven method. Analyze the nutritional value of corn silk powder; Develop product by incorporating the corn silk powder; Observe the shelf life of the corn silk powder and value added herbal product and estimate the nutrient contents of the value added herbal product using corn silk powder. In order to fulfill the objectives corn silk was selected from field corn and it is dried in sun dry method and hot air oven method. The main purpose of using these methods are to lower the water content and reduce the food spoilage by micro organism.The physical and mechanical methods are used to develop the corn silk powder and determined the best effective method to develop the product. The nutrients like Energy, Carbohydrate, Protein, Fat, Dietary fiber, iron,

Sodium, Potassium, Vitamin C, Vitamin B12, β Carotene ash, antioxidant capacity, besides this the presence of heavy metals were analysed Hence texture analysis is done to find out hardness of force required to bite the product.

Standardization of recipe was done thrice to find out the desirable quality of the product. In this study three different recipes like soup mix powder, tea powder and herbal biscuit were selected and standardized.The sample is tested under hedonic rating scale to measure the consumer acceptability of food products. From one to three samples are served to the untrained panelist at one session. The acceptability of the product on the scale, usually of 9 points ranging from 'like extremely' to 'dislike extremely'. Finally statistical test is revealed namely mean and t-test were analysed to find out the acceptability of value added products prepared with various level of variations.

The food items namely soup mix powder, tea powder and biscuits were selected. Initially standard products with three variations were done and selected the most acceptable product by following sensory evaluation with a help of untrained panel members. Among the best standard recipes namely S1 soup mix powder, S2 tea powder, S3 biscuits were highly accepted. With regard to soup mix standard 1 with the mean sensory score of 39±5.07 was selected. Its composition was 100ml of water, 1g soup and prepared at 105ºC.

The standard S2 which obtained the highest sensory evaluation score of 30±4.7 with a combination of 2g of tea powder with 150ml of water prepared at 103ºC was selected. Likewise, biscuits were prepared at different standards to get a acceptable quality of the product. The standard 3 with the mean scores of 34±6.3 was selected. Three variations of value added products by incorporating corn silk powder were developed. The value added products were also evaluated by acceptability test using 9 point hedonic scale. The variations which obtained the highest score was selected. By following standard procedure nutrient content were analysed. The shelf life of the corn silk powder stored in glass container was checked in terms of moisture content, microbial content and fungal growth after 45^{th} day to ensure quality of the corn silk powder.

The results of the present study are summarized below :-

- Corn silk powder was prepared by sun dry and hot air oven method.

- The nutrient content of corn silk powder namely carbohydrate, protein, fat and dietary fiber were more or less similar in both the drying methods.
- The potassium content of corn silk powder dried by hot air oven was higher by 630mg as against sun dry method. It is also noted that retention vitamin C, β carotene and ash content of corn silk powder were more in sun dry method.
- The shelf life of the corn silk powder dried by both the methods were highly satisfactory as the moisture content and microbial content were at within the limit.
- It is also noted that corn silk powder was free of fungal count. Hence it is observed that the quality of corn silk powder is safe after 45 days of storage.
- The antioxidant capacity of the corn silk powder dried by sun dry and hot air oven method were ranged between 50 and 53 µg of ascorbic acid which is highly acceptable. The heavy metal nickel was not noticed in corn silk powder dried by both the methods. Though lead is detected it is with the safely level as per FAO suggested.
- As the quantity of soup mix powder is increased, the requirement of water is also increased in the preparation of standard soup.
- Based on the sensory evaluation standard 1 soup had highest score for all the attributes like appearance, colour, flavor, taste, consistency and the total mean score was 34±5.07.
- As the addition of corn silk powder is increased, water requirement is also elevated to get the desired quality of soup incorporated with corn silk powder.
- It is observed that variation 1 with the addition of 1g soup powder, 1g of corn silk powder and 120ml of water at 110ºC had the maximum hedonic scores and found to be highly acceptable.
- With regard to standard tea preparation water requirement and time is gradually increased with the addition of tea powder to get the desirable light tea.
- The standard 2 tea was highly acceptable since it was light tea, flavor and taste were good, colour was light yellow and had highest sensory evaluation score of 28±5.0
- The tea prepared by incorporating corn silk powder showed that minimum quantity of tea powder and more quantity of water is required to prepare a light tea within 10 minutes at 110ºC

- The variation 2 with the addition of 2g of tea powder and 1g incorporation of corn silk powder had good appearance, desirable colour, flavor and taste.
- Biscuits was prepared by keeping the other ingredients like jaggery, butter and egg constant and time 15minutes and temperature 120ºC is also at constant level.
- Standard 3 biscuit with the combination of 10g whole wheat flour,20g refined wheat flour with constant quantity of other ingredients had the highest score of 34±6.3 and found to be highly acceptable.
- Biscuit incorporated with corn silk powder was prepared with the alteration only in corn silk powder and egg to get a highly acceptable product.
- The variation 1 with the incorporation of 1g corn silk powder biscuit had the highest score for appearance, colour, flavor, taste and texture.
- The incorporation of corn silk powder enhanced the nutrient content of dietary fiber and protein.
- The soup mix powder was found to be rich source of protein 12g, dietary fiber 8g, sodium 540mg, and potassium 1200mg. Tea is found to be rich in dietary fiber 15g.
- Herbal biscuit was found to be rich in dietary fiber, protein with the addition of egg and corn silk powder.
- The moisture content and total bacterial count of the formulated value added product incorporated with corn silk powder namely soup powder, tea powder and herbal biscuit were at safety level and it is free of fungal growth.
- The texture analysis revealed that there is no difference in the acceptability of biscuit for standard as well as the biscuit with the incorporation of 1g corn silk powder.

Recommendation for future study

- Corn silk is a waste by product from the field corn and in many food processing industry it is discarded as waste and feed to animals therefore utilization is less and it is not much aware about the silk.
- Corn silk acts as medicinal property in both curative and preventive aspects. Hence study on extraction of corn silk is used to treat the major disease like diabetes, kidney damage and
- Effectiveness of corn silk powder can be studied among the obese subjects.

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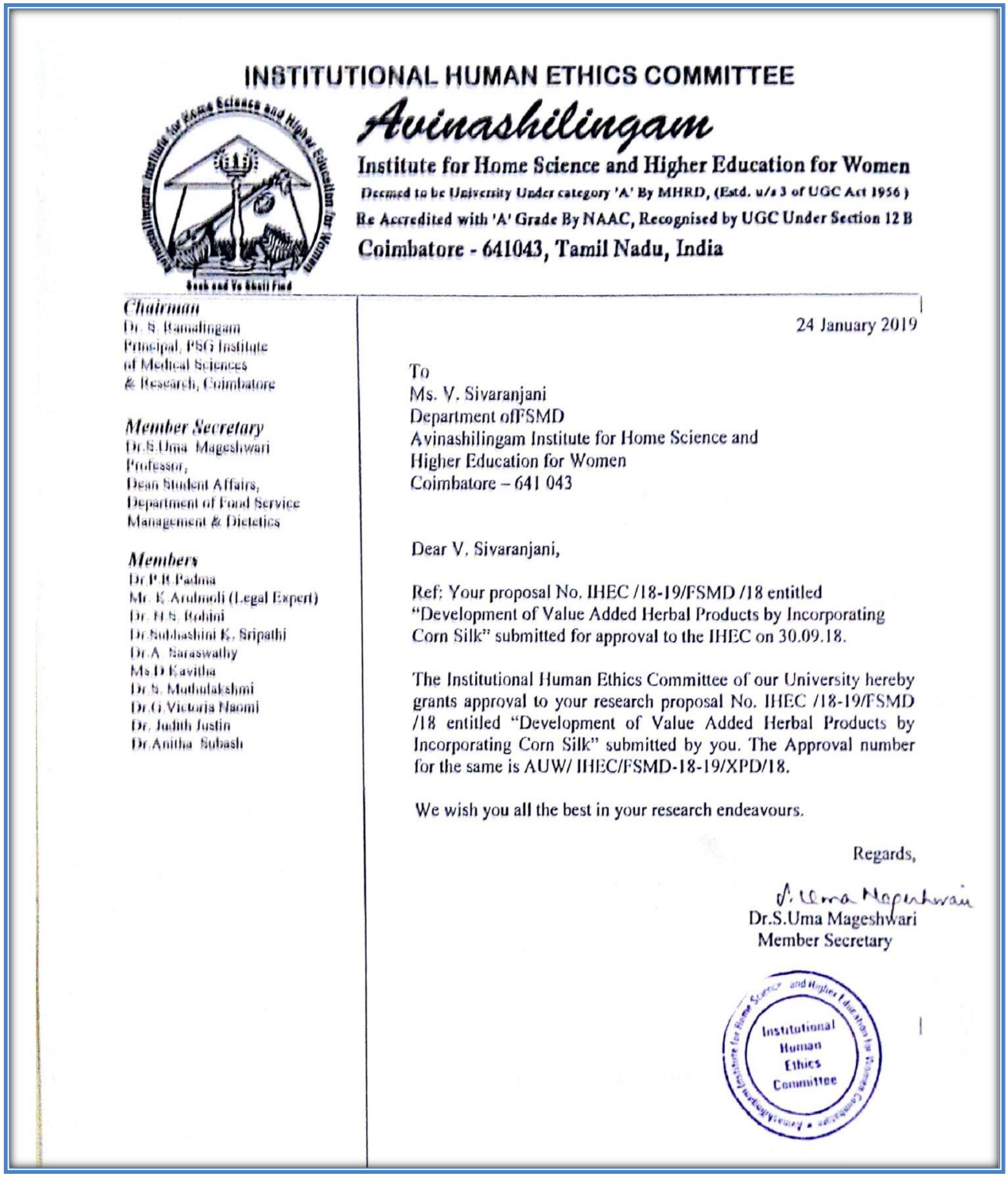
https://www.persistencemarketresearch.com/market-research/corn-silk-extract-market.asp

ANNEXURE 1

ETHICAL CLEARANCE COMMITTEE



INSTITUTIONAL HUMAN ETHICS COMMITTEE

Avinashilingam

Institute for Home Science and Higher Education for Women

Deemed to be University Under category 'A' By MHRD, (Estd. u/s 3 of UGC Act 1956)

Re Accredited with 'A' Grade By NAAC, Recognised by UGC Under Section 12 B

Coimbatore - 641043, Tamil Nadu, India

Chairman
Dr. S. Ramalingam
Principal, PSG Institute
of Medical Sciences
& Research, Coimbatore

Member Secretary
Dr.S.Uma Mageshwari
Professor,
Dean Student Affairs,
Department of Food Service
Management & Dietetics

Members
Dr.P.R.Padma
Mr. K. Arulmoli (Legal Expert)
Dr. H.S. Rohini
Dr.Subhashini K. Sripathi
Dr.A. Saraswathy
Ms.D.Kavitha
Dr.S. Muthulakshmi
Dr.G.Victoria Naomi
Dr. Judith Justin
Dr.Anitha Subash

24 January 2019

To
Ms. V. Sivaranjani
Department ofFSMD
Avinashilingam Institute for Home Science and
Higher Education for Women
Coimbatore – 641 043

Dear V. Sivaranjani,

Ref: Your proposal No. IHEC /18-19/FSMD /18 entitled "Development of Value Added Herbal Products by Incorporating Corn Silk" submitted for approval to the IHEC on 30.09.18.

The Institutional Human Ethics Committee of our University hereby grants approval to your research proposal No. IHEC /18-19/FSMD /18 entitled "Development of Value Added Herbal Products by Incorporating Corn Silk" submitted by you. The Approval number for the same is AUW/ IHEC/FSMD-18-19/XPD/18.

We wish you all the best in your research endeavours.

Regards,

Dr.S.Uma Mageshwari
Member Secretary

Institutional Human Ethics Committee

ANNEXURE 2

SENSORY EVAULATION FOR DEVELOPED PRODUCT

VARIATION 1

NAME :-			PRODUCT NAME:-		
PANELIST NO:-			DATE:-		
INSTRUCTIONS:- Taste the given samples, then mark on the point in the scale which best describes your feeling.					
SCORE	Appearance	Colour	Flavor	Taste	Consistency
Like extremely					
Like very much					
Like moderately					
Like slightly					
Neither like nor dislike					
Dislike slightly					
Dislike moderately					
Dislike very much					
Dislike extermely					

Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

VARIATION 2

NAME :-		PRODUCT NAME:-			
PANELIST NO:-		DATE:-			
INSTRUCTIONS:- Taste the given samples, then mark on the point in the scale which best describes your feeling.					
SCORE	Appearance	Colour	Flavor	Taste	Consistency
Like extremely					
Like very much					
Like moderately					
Like slightly					
Neither like nor dislike					
Dislike slightly					
Dislike moderately					
Dislike very much					
Dislike extermely					

Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

VARIATION 3

NAME :-		PRODUCT NAME:-			
PANELIST NO:-		DATE:-			
INSTRUCTIONS:- Taste the given samples, then mark on the point in the scale which best describes your feeling.					
SCORE	Appearance	Colour	Flavor	Taste	Consistency
Like extremely					
Like very much					
Like moderately					
Like slightly					
Neither like nor dislike					
Dislike slightly					
Dislike moderately					
Dislike very much					
Dislike extermely					

Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

ANNEXURE 3

PLAGIARISM

Urkund Analysis Result

- Analysed Document: plagarism.docx (D50931161)
- Submitted: 4/23/2019 9:09:00 AM
- Submitted By: library@avinuty.ac.in
- Significance: 0 %

Thus the present study is an attempt to create novel food products by value addition with corn silk powder and to analyse the nutritional composition and shelf life of the product to be essential for the healthy life.

Hence the present study has been undertaken with the **broad objective** of

- Development of Value added herbal products and assess its acceptability and nutrients content.

The **specific objectives** of the study are to

- Prepare corn silk powder.
- Analyze the nutritive value of corn silk.
- Develop product by incorporating the corn silk powder.
- Observe the shelf life of the corn silk powder and value added herbal product and
- Estimate the nutrient contents of the value added herbal product using corn silk powder.