Green Coffee Beans as Nutraceuticals

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Abstract-
Introduction
Green coffee beans have nutrients like fats. protein and carbohydrate. It also contains chlorogenic acid, phenols, brown pigments, trigonelline & caffeine. Its brown pigments, chlorogenic acid & phenols are good sources of antioxidants which can prevent chronic diseases like cardiovascular diseases, hepatic diseases, cancer, diabetes, obesity and aging.
Purpose
In this article we determined the processing of green coffee beans, its constituents, pharmacokinetics, specific mechanisms on treating diseases like obesity, oxidative stress, type 2- diabetes, cardiovascular disease, cancer, hepatic disorders, anti-aging effect and some risk effects associated with green coffee bean consumption.
Methods
It is done by literature review by using some keywords like "Green coffee bean", "nutraceutical", "and "processing", "therapeutic effects" and "risk factors" by search engines like Google scholar, Web of science, Scopus and Pub-med.
Results
After reviewing many articles, it was determined that being a Nutraceutical, green coffee beans can prevent and treat oxidative stress and chronic diseases but have some risk factors like liver toxicity, damages to the cells and enzymatic interactions, metabolic reactions and biological response system interference in many patients.
Conclusion
From the literature review we have concluded that green coffee beans consumption in normalize amount can treats chronic diseases but to minimize side effects, avoid too much consumption of green coffee beans.

Index Terms- Coffee beans, Nutraceuticals, Pharmacokinetics, Antioxidant, Processing,

I. INTRODUCTION

Green coffee bean has been used worldwide as a useful drink because of its nutitional importance. It is a good supply of various therapeutic and nutritional constituents like minerals, lipids, nitrogenous substances, vitamins and carbohydrates. It also contains some biologically active compounds such as Kahweol diterpenes, Chlorogenic acid, Caffeine and Cafesol which are all therapeutically active.
The green coffee bean's bioavailability can be improved by new techniques like coffee capsule technique & nanencapsulation.
Many studies were conducted on green coffee beans to indentify its consumption effect on health of humans. The studies showed that green coffee beans possess antioxidant property, which can be due to its phenolic constituents. Although it has been suggested that roasting of green coffee beans can convert them to dark beans, which can alter their antioxidant activity. [1,2]

Processing of Green Coffee Beans
During collection/ harvesting, green tea is manufactured by the berries (Cherries) of green coffee plant via series of complex processes, performed in various countries. The problem is to be faced in removing seeds of the coffee from many layers of the berries. This has to be done in very effective way. This will provide green coffee which can be marketed having a moisture content of < 12% to 13%.
From centuries two key procedures have been utilized, which are traditionally known as,
1) Dry Process
2) Wet Process

Both of them are different in approach. Green coffee beans which are different through geographical area and Species, are prepared via these procedures are called as
- Natural Green Coffee (Prepared via Dry process)
- Washed Green Coffee (Prepared via Wet process)

Moreover, apart from several Sorting and grading technologies, various polishing and Cleaning methods are also carried out to give final finished green coffee beans as per specification for the purpose of Export.[3]

Dry Processing

Dry processing is used for preparation of robust green coffee. In Brazil, this process is used for the preparation of Arabica green coffee. This process is very significant and simple. As regards to harvesting, this process is not much demanding. After harvesting, the green tea berries will dried instantly. [4]

Wet processing

Wet processing is used for the preparation of Arabica Green Coffee. When in preparation process fermentation is involved it will make mild green coffee. This process needs severe and strict control on harvesting because unripen cherries or berries will dried partially on its tree and will not be cut via pulping machine. [4]

Constituents

The green coffee beans have following constituents.

- Volatile constituents (Alkanes, Alcohol and Aldehyde)
- Esters
- Diterpene Ester
- Ketone
- Cafestol palmitate
- Coumarins
- P-methoxyphenol
- α- angelica lactone
- Benzyl isothiocynate[5]
- Lipids
- Chlorogenic acid
- Sucrose
- Caffeine
- Proteins
- Total polyphenols [6]

Pharmacokinetics

A green tea cup of 200ml contains Epigallocatechin gallate in a concentration of 112mg, Epigallocatechin in a concentration of 51mg and Epicatechin in a concentration of 15ml. The maximum plasma concentration (C_{max}) of free constituents and bound glucuronide and Sulfate conjugates will be 125 nM, 76 nM and 181 nM correspondingly along with 51 nM of methyl-Epicatechin and 94 nM methyl-Epigallocatechin having a Standard deviation of 20%.

Green tea is very rich in Flavan-3-ol Monomers. A study is conducted in which 500ml tea of green tea beans was consumed by 10 individuals. Then after 24 hours, urine and plasma samples were taken. The sample of green tea contains total Six hundred forty eight mmol Flavan-3-ol mainly in form of 230 mmol Epigallocatechin-3-0-gallate, 36 mmol Gallocatechin, 257 mmol Epigallocatechin, 49 mmol Epicatechin-3-0-Gallate and 58 mmol Epicatechin.

Two natural green coffee beans Flavan-3-ols Epigallocatechin-3-0-gallate & Epicatechin-3-0-gallate were found in human plasma via HPLC-MS technique together with methyl-glucuronide, Glucuronide & Methyl-Sulphate metabolites of Glucuronide, Catechin's methyl sulfate and Sulfate metabolite and glucuronide.

Profiles of Pharmacokinetic of flavan-3-ols 8 groups shows its maximum and toxic concentrations. Maximum concentration (C_{max}) ranges from 25nM-126 nM and Toxic Concentration (T_{max}) ranges from 1.6h- 2.3 hours. Maximum toxic concentration (T_{max}) and profile of pharmacokinetics shows the absorption of Flavonoids in SI i.e. Small Intestine. The presence of non-metabolized flavonoids in huma n plasma is not common. The movement of Epigallocatechin-3-0 Gallate and Epicatechin-3-0-gallate from Small intestine wall to the circulation deprived of metabolism shows the significance of appearance of 3-0-Galloyl moeities because Gallate itself absorbed and shows excretion in urine of 37% of consumption.[7,8]

Mechanism and clinical evidences:

Obesity and weight loss

Weight loss activity of green tea beans and its isolated active phytoconstituents have been evaluated both In-vitro in cultures of cells and in-vivo in animal models. It shows healthy benefits in both models. It also reduces adipose tissues by decreasing the proliferation and differentiation of diposites. It also shows good result in profile of lipids and metabolism of Carbohydrate and lipid.

Numerious studies have been conducted on Green tea beans to evaluate its effect on Increase weight or obesity. A study is conducted which shows that phytoconstituents present in Green tea beans are administered to Winstar male rats in the form of Dinking water. Green tea was given at doses of 0.8g/l, 1.6g/l and 3.2g/l. These winster rats took a high fat containing diet till twenty six weeks. The green tea reduces the accumulation of adipose tissues around visera.

In another study, to obese mice who took diet with high fat till 8 weeks, green tea beans extract in a dose of 400mg/ kg/ day was given. It will increase the Perilipin found in mesenteric adipose tissues and Hormone sensitive lipase. Both of these are linked with the reduction of weight of body. [9]

Oxidative Stress

The Green tea beans anti-oxidant studies has studied broadly. Green tea beans are given with diet. The outcomes of these studies are vary. In one study, we evaluated action of two green tea cups consisting of 250mg Catechins with diet which is controlled in healthy individuals. This group is compared with another group who are taking the similar diet but no Green tea. In both groups, at the starting and at the end of the study, resistance to damage by oxidation in DNA and Lipid, plasma lipid profile, in Isolated lymphocytes Glutathione peroxidase activity were evaluated.

After forty two days of Green tea consumption. There is increase in Anti-oxidative action in plasma from 1.79 Amol Trolox Equivalent/ml to 1.98 Amol Trolox Equivalent/ml. There is also reduction in peroxide levels in plasma from 14.2% of DNA in Tail to 10.1% of DNA in tail. A reasonable reduction in Low density lipoprotein Cholestrol from 119.9 mg/dl to 106.6 mg/dl. All of these were measured in comparison to control.

This study shows that Green tea when consumed with balanced diet is able to reduce oxidative stress and also protects towards damaged by Oxidation in human beings.[10]

Type 2 Diabetes

Regular intake of green tea beans by diabetic patient for numerous months is not effective in reducing diabetic parameters like HbA1C, Levels of blood glucose, inflammatory markers and resistance of Insulin. Many trails shows that green tea beans are effective in Type-2 diabetes Melitus.

Some clinical trails shows that in Green tea beans, Epigallocatechin gallate is very rich catechin that reduces Adipocytes differentiation and proliferation, blocks mikcelle formation of lipid and sodium dependent transporter of glucose in intestine and enhance defense of cells to oxidative stress.

Although the required amount of Epigallocatechin gallate to reduce the Adipocytes and Pre-adipocytes number, is very high to be taken via humans having no adverse effect. However, Green tea catechin consist of Molecular skeleton that use as a free radical scavanger of Oxygen. But its action in biological systems is not identified. Most studies shows that Epigallocatechin gallate is the prooxidant and effects survival of β-Cells in Diabetic rats (Streptozotocin induced).

The most dominant Anti-diabetic mechanism of Green tea beans is the blocking of Micelle formation of lipid and $SGLT_1$. This is an effective mechanism against Type-2 Diabetes Melitus treatment. [11]

Cardiovascular Disease

Green tea beans are used for making renowned drink. It has antioxidant as Polyphenol, that are able to reduce the possibility of Cardiovascular disease (CVD), Atherosclerosis &Coronary Artery Disease (CAD). In a study we determined that the intake of green tea is inversely related to reduce prevelance of Cardiovascular, Cerebrovascular disease and Coronary artery disease.

This trial consisted of 203 patients whom went through Coronary Angiography. One hundred and nine patients were of CS i.e. Coronary stenosis while ninety four patients were not. In these pts the incidence of Coronary artery disease were analyzed by taking events of Cerebrovascular and Cardiovascular disease.

The ingestion of Green tea was more in patients of Coronary Artery disease as compared with patients who were without CAD. Then evaluate the influence of Green tea consumption on CAD i.e. Coronary artery disease incidence.

The consumption of Green tea on each day of trial reduce the incedence of Cerebrovascular and Cardiovascular diseases.

From the above study we have concluded that the intake of Green tea can decrease the Coronary Artery disease &Cardiovascular and Cerebrovascular disease incidence. Thus, more the green tea the patients intake, more lessely they develop Cardio vascular diseases and Coronary Artery diseases. [12]

Anti-Cancer Activity

Green tea beans has been known as a highly potent drug for health maintenance via Japanese and Chinese. It is also used to prolong life. Currently, a study trial was performed/ conducted to determine the action of Green tea beans active phytochemical Epigallocatechin-3-gallate (EGCG) on B-Cells having Chronic and Severe lymphocytic leukemia. These cells were isolated from patients of Leukemia.

These B-Cells resist to apoptosis due to secretion and binding to VEGF i.e. Vascular Endothelial Growth Factor. VEGF is an effective angiogenic Cytokines which act as a Critical factor of Survival to Cancer Cells.

The studies have shown that Green tea's Epigallocatechin gallate when added to these cells, then phosphorylation of VEGF Receptor were obviously reduced. This will lead to Vascular Endothelial growth factor- dependent autocrine pathway disturbance which will prevent cells from Cell death and Apoptosis. [13]

Hepatic Disorders:

Action of extract of a green Tea Beans on Non-Alocholic Fatty Liver Disease (NAFLD)

NAFLD i.e. Non-Alcoholic fatty liver disease is the main health problem in entire worldhaving no any treatment. Extract of a Green Coffee bean have many biologically active phytoconstituents having many physiological and biochemical action.

A study is carried to evaluate the actions of extract of Green coffee beans on Non-alcholic fatty liver disease patient's treatment. In this study forty four patients of non-alcoholic fatty liver disease was taken &this study was double blind trial which is placebo controlled. To these patients placebo or Green coffee beans extract were administered in a dose of 1gm/day till 8 weeks. Full balanced diet with physical exercise were recommended to these patients. Then before and after treatment Anthropometric, Biochemical parameters and Ultrasound of liver were evaluated.

The study shows that extract of green coffee beans enhanced the AST (Aspartate aminotransferase), Total Cholestraol, FBS (Fasting blood sugar), TG (Triglyceride), hs-CRP (High sensitivity C- reactive protein), HOMA-IR (Homeostasis model assessment insulin resistance), TAC (Total antioxidant Capacity) and FFA (Free fatty acids) levels with comparing to placebo group. While there was no any changes and difference between in HDL & LDL Cholestrol and their retios, steatosis degree, Body weight, TNF-α, Alkaline phosphatase and Aspartate transamine levels in both of the groups.

From this trial we have concluded that supplementation with extract of Green coffee beans will absolutely gives positive advantages to Non-Alcoholic fatty liver disease patients. These advantagious effect might be because of Green coffee beans ability to enhance sensitivitry of insulin, Antioxidant and Anti-inflammatory activity. [14]

Anti-aging and Cosmetic Effect of Green Tea

The green coffee beans have polyphenols which has Radical scavenging effect, this effect will enable it to use for Antiaging treatment. In a study green tea beans aqueous extract was applied to mice skin. It was found to treat the mice skin which is effected via Photoaging. It was observed that green coffee beans extract enhanced the Elastin fibers and collagen levels and decrease the Collagen degrading MMP-3 enzymes expression. And then exerts anti-wrinkle activity.

In another clinical trial polyphenols of Green coffee beans in a Capsule form were given to Human volunterrs for a some time and it was evaluated that Catechins of Green coffee beans will conjugate its metabolites in samples of Blister fluid, plasma and skin biopsy.

In one clinical trial, Eighteen volunteers in a range of 21 years to 71 years were applied placebo and an extract of green cofffee beans topically prior to an Ultra violet rays exposure. The bioopsy is performed and erythema level is tested which indicates that green coffee beans decrease the cells number in part of sunburn skin as compared with pre-treated skin.

In another study an extract of Green coffee beans were applied to Crow's feet, which are wrinkles in eyes outer corner, in forty two korean females Bid continously for 8 days then it was investigated that green coffee beans extract has Free radical scavanging effect and it also exerts anti-wrinkle action in volunteers.

In a placebo controlled single blind study, fifty six randomly selected females having ages between 25 – 75 years were administered oral supplements of Green coffee beans polyphenols 250mg and placebo till 2 years. It was shown that Green coffee beans polyphenols improved skin of the face and controlled Erythema. [15]

Risk to Human Health

In the Current years green coffee beans intake has increases. Side by side its liver toxicity and adverse effects report has also increased which are suggested as because of damges to the cells and enzymatic interactions, metabolic reactions and Biological response system interference.

Many researches on Green coffee bean exract have shown that it can cause damage to the liver, it can cause interaction with Prescription medicine via altering their efficacy and can be a reason of harm to health when given with other herbal drugs.

In some cases, at normal doses of green coffee bean intake in human will causes some side effects. Green coffee beans catechin can decrease the drug-metabolizing enzymes actions, effect transporter of drugs and effect their expression both downregulation and upregulations.

A study shows that administration of green coffee beans catechin can effect the metabolism of drugs which are metabolized via Different Cytochrome Enzymes. [16, 17,18]

II. METHODS

A review was done systematically of the articles on green coffee beans for this study.

Searching strategy

The literature survey was done from 30th September, 2023 to 31st October, 2023. The search was done by means of keywords "Green coffee beans", "processing", "therapeutic effect" and "risk factors" in search engines like Google scholar, Web of science, Scopus and Pub-med. The search was restricted by setting timeframe between 2009 to 2023.

Inclusion criteria

- Literature on green coffee beans in English.
- Reported studies were done on green coffee beans during past 14 years.

Exclusion criteria

- Studies don't have clear explanation about green coffee beans.
- Studies conducted on black coffee beans after processing of green beans.

Data collection & evaluation

Selection of literature based on abstracts and complete articles on green coffee beans.

Data extarction

The below mentioned data from each article were evaluated and noted:

- Processing of green coffee beans
- Constituents
- Pharmacokinetic
- Pharmacodynamics & clinical evidences

III. Result

The searched literature resulted in 365 best suited articles on title. Out of which 18 meet the searched criteria. The study evaluated different aspects of green coffee beans like its processing (Wet & dry processing), phytochemicals, Pharmacokinetics and mechanism of green coffee bean extract in treating chronic diseases like Oxidative stress, hepatic diseases, type 2-diabetes, cardiovascular disease, cancer and obesity.

IV. Conclusion

From the literature review we have concluded that nutrients of green coffee beans like brown pigments, chlorogenic acid & phenols, being antioxidants can treat and prevents the risk of many chronic diseases like cardiovascular, hepatic diseases, diabetes, cancer, aging, wrinkles, erythema and diabetes but if we consume in excessive anount, it can effect enzymatic interactions, metabolic reactions and can interfere in biological response system of body. So, we have to take green coffee beans in normalize amount and avoid too much consumption of green coffee beans.

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VI. Conflict of Interest

There is no any conflict of interest in doing this research work.

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