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The Effects of Goko Cleanser on the Hypothalamus and Pancreatic Histomorphology in Adult Male Wistar Rats

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Abstract

The widespread use of herbal mixtures has grown substantially in recent years, driven largely by the perception that plant-based remedies are safe, natural, and capable of providing multiple therapeutic benefits. Herbal formulations such as Goko Cleanser are commonly consumed to manage conditions including diabetes, fever, gastrointestinal disturbances, joint pains, and appetite regulation. Despite these perceived advantages, concerns remain regarding the potential toxic effects of these products on vital organs, particularly when consumed in high doses or over extended periods. In this context, careful scientific evaluation is essential to determine both the efficacy and safety of such herbal preparations. This study investigated the effects of Goko Cleanser on hypothalamic oxidative stress markers and the histomorphology of the pancreas in adult male Wistar rats. Twenty rats weighing between 160 g and 250 g were selected for the experiment and randomly assigned into four experimental groups (G1–G4) based on their body weight to ensure uniformity across treatments. Group 1 (G1) served as the control and received 10 ml/kg of normal saline or distilled water orally. Group 2 (G2) received 1000 mg/kg of Goko Cleanser, Group 3 (G3) received 1500 mg/kg, and Group 4 (G4) received 2000 mg/kg orally. Treatments were administered daily over a period of 21 days to evaluate both subacute and potential cumulative effects of the herbal mixture.Results from the study demonstrated that oxidative stress markers in the hypothalamus, including superoxide dismutase (SOD), catalase (CAT), and malondialdehyde (MDA), did not differ significantly ($P > 0.05$) across the experimental groups. These findings suggest that, within the duration and dosage used, Goko Cleanser did not elicit substantial oxidative damage in the hypothalamic tissue, although minor adaptive responses in antioxidant activity were observed. Glucose levels also remained largely stable across all groups, indicating that the herbal formulation did not significantly impair pancreatic endocrine function during the study period. However, body weight of the experimental rats increased significantly ($P < 0.05$) over the course of the study, with the most notable gains occurring in the first week of treatment. This suggests that Goko Cleanser may influence energy metabolism and nutrient assimilation, possibly through mild

effects on appetite regulation or glucose utilization. Histological analysis of pancreatic tissue revealed dose-dependent alterations. At higher doses, particularly in groups 3 and 4, evidence of pancreatic tissue inflammation and subtle structural changes, such as loosely packed Langerhans islets and focal fatty changes in interlobular connective tissue, were observed. These alterations point to potential disruptions in both endocrine and exocrine functions of the pancreas, which could have long-term metabolic implications if the herbal mixture is consumed in large quantities or over prolonged periods. In conclusion, this study provides evidence that while Goko Cleanser does not significantly affect hypothalamic oxidative stress or glucose levels in the short term, prolonged or high-dose administration may pose risks to pancreatic tissue integrity and overall metabolic function. These findings underscore the importance of caution in the therapeutic use of Goko Cleanser.

Keywords:

Goko Cleanser, Hypothalamus, Pancreas, Oxidative Stress, Histomorphology, Wistar Rats.

Introduction

In both developed and developing nations, herbal medicine is widely utilized, particularly among rural populations (World Health Organization [WHO], 2019). The reliance on herbal remedies in these settings is often shaped by long-standing cultural beliefs, limited access to orthodox healthcare facilities, and the relatively low cost of plant-based treatments (World Health Organization [WHO], 2019). For many individuals, herbal medicine represents not just an alternative, but sometimes the only available form of healthcare. The increasing use of herbal formulations has also been fueled by the perception that "natural" equates to "safe," leading to widespread, and in some cases, indiscriminate consumption (Ekor, 2014). However, this assumption does not always hold true. Many medicinal plants contain potent bioactive compounds that can exert pharmacological as well as toxic effects, especially when taken in excessive quantities or over long periods (Anywar et al., 2021). Some of these compounds may accumulate in vital organs such as the liver and kidneys, gradually impairing their functions (Ekor, 2014). As noted by Anywar et al. (2021), the toxic potential of herbal preparations is often overlooked, particularly in mixtures where multiple plant constituents may interact in unpredictable ways.

Goko Cleanser is a polyherbal formulation composed of Vernonia amygdalina, Saccharum officinarum, Allium sativum, Cajanus cajan, caramel, and Zingiber officinale. Each of these components has been individually recognized for its medicinal value, ranging from antioxidant and anti-inflammatory properties to antimicrobial and hypoglycemic effects (Okwu, 2005; Akinmoladun et al., 2007). As a result, the formulation is widely consumed for the management of various conditions such as diabetes mellitus, fever, joint pains, gastrointestinal disturbances, and appetite regulation (Akinmoladun et al., 2007). Despite these perceived benefits, the combined use of multiple plant extracts in a single preparation raises important concerns. The interaction between different phytochemicals may lead to synergistic effects that amplify toxicity, or antagonistic effects that alter their expected therapeutic outcomes (Ekor, 2014). Furthermore, repeated consumption may result in the gradual accumulation of active compounds within the body, potentially leading to organ damage (Anywar et al., 2021). These considerations highlight the need for careful scientific evaluation of such widely used herbal mixtures.

The hypothalamus is a vital part of the brain located below the third ventricle and above the pituitary gland. It serves as a key regulatory center, linking the nervous system to the endocrine system through its control over the pituitary gland. By secreting releasing and inhibiting hormones, the hypothalamus plays a central role in regulating growth, fluid balance, reproduction, and metabolism (Stagkourakis et al., 2019). Beyond its endocrine functions, it is also deeply involved in maintaining homeostasis by regulating appetite, body temperature, circadian rhythms, and autonomic nervous system activities (Lechan & Toni, 2016). Because of its strategic position and wide range of functions, the hypothalamus is particularly sensitive to toxic insults. Any damage to its nuclei can disrupt hormonal balance and impair critical physiological processes, potentially leading to metabolic disorders, reproductive dysfunction, and altered stress responses (Lechan & Toni, 2016). Oxidative stress is a major mechanism by which toxic substances induce neuronal damage. It arises when there is an imbalance between the production of reactive oxygen species and the body's ability to neutralize them through antioxidant defenses (Halliwell & Gutteridge, 2015). In the brain, excessive free radicals can attack cellular components, particularly lipids in neuronal membranes, leading to lipid peroxidation and subsequent cell damage. This process has been strongly implicated in the development of several neurological disorders (Halliwell & Gutteridge, 2015). Malondialdehyde is commonly used as a biomarker of lipid peroxidation, with elevated levels indicating increased oxidative damage (Ighodaro & Akinloye, 2018). On the other hand, antioxidant enzymes such as superoxide dismutase and catalase play protective roles by neutralizing harmful free radicals. A reduction in the activity of these enzymes suggests a weakened antioxidant defense system (Ighodaro & Akinloye, 2018). Therefore, assessing these markers provides valuable insight into the extent of oxidative stress and tissue injury.

The pancreas performs both endocrine and exocrine functions. Its endocrine component, represented by the islets of Langerhans, is responsible for the secretion of hormones such as insulin and glucagon, which are essential for the regulation of blood glucose levels (Blausen et al., 2014). The exocrine portion, on the other hand, produces digestive enzymes that facilitate the breakdown of carbohydrates, proteins, and fats in the small intestine (Betts et al., 2013). The proper functioning of the pancreas is therefore critical for both metabolic balance and digestion. Structural damage to pancreatic tissue can compromise these functions, leading to disturbances in glucose homeostasis and impaired digestion. Conditions such as pancreatitis and diabetes mellitus have been closely associated with pancreatic injury (Betts et al., 2013).

Oyagbemi et al. (2016) found that Wistar rats exposed to herbal substances showed significant biochemical alterations including elevated oxidative stress markers. This may be indicative of damage to pancreatic beta cells, which are responsible for insulin production. When these cells are impaired, insulin secretion is reduced, leading to decreased glucose uptake by body tissues and a subsequent rise in blood glucose levels. Similarly, Akinmoladun et al. (2007) reported metabolic alterations following exposure to plant extracts, further suggesting a disruption in glucose regulation. These findings collectively point to the possibility that herbal formulations may interfere with pancreatic function, potentially through their phytochemical constituents. In addition, Yadav and Lowenfels (2013) observed that elevated serum levels of amylase and lipase are key indicators of pancreatic injury. These enzymes are commonly associated with pancreatic inflammation or damage, such as in cases of pancreatitis. The convergence of these biochemical findings provides strong evidence that prolonged exposure to herbal mixtures may adversely affect pancreatic health.

Given the central roles of the hypothalamus and pancreas in metabolic and endocrine regulation, this study investigated the effects of Goko Cleanser on hypothalamic oxidative stress markers and the histomorphology of the pancreas in adult male Wistar rats.

Statement of the Problem

Goko Cleanser is widely consumed for various therapeutic purposes without adequate scientific evidence on its safety, particularly with prolonged use. While its effects on peripheral organs have raised concerns, limited attention has been given to its potential effects on the brain and pancreas. Damage to the hypothalamus and pancreas may result in serious neuroendocrine and metabolic dysfunctions. There is therefore a need to evaluate the effects of Goko Cleanser on hypothalamic oxidative stress markers and pancreatic histomorphology.

Objectives of the Study

The general objective of this study is to evaluate the effects of Goko Cleanser on the hypothalamus and pancreatic histomorphology in adult male Wistar rats.

The specific objectives are to:

1. Assess the effects of Goko Cleanser on oxidative stress markers in the hypothalamus.
2. Evaluate the histomorphological changes in the pancreas following administration of Goko Cleanser.

Research Hypotheses

1. Goko Cleanser has no significant effect on hypothalamic oxidative stress markers in adult male Wistar rats.
2. Goko Cleanser has no significant effect on pancreatic histomorphology in adult male Wistar rats.

Materials and Methods

Procurement of Experimental Substance

Goko Cleanser was purchased from a registered herbal medicine outlet and stored according to the manufacturer's instructions prior to administration.

Experimental Animals

Twenty adult male Wistar rats weighing between 160 and 250 g were obtained, housed under standard laboratory conditions and allowed to acclimatize for two weeks before the experiment commenced.

Experimental Design

The animals were randomly divided into control and treatment groups and administered graded doses of Goko Cleanser orally for a period of twenty-one days.

Table 1: Experimental grouping and dosage regimen of Goko Cleanser

EXPERIMENTAL GROUP	NO OF RATS	TREATMENT	DOSAGE /kg/body weight	DURATION
GROUP1 (NORMAL CONTROL)	5	Distilled water	10ml/kg	21days
GROUP 2	5	Goko Cleanser	1000mg/kg / (orally once daily)	21days
GROUP 3	5	Goko Cleanser	1500 mg/kg (orally once daily)	21days
GROUP 4	5	Goko Cleanser	2000 mg/kg (orally once daily)	21days

Sample Collection

At the end of the experimental period, the animals were anaesthetized and the hypothalamus and pancreas were carefully excised for biochemical and histomorphological analyses.

Oxidative Stress Analysis

Hypothalamic tissues were homogenized and analyzed for malondialdehyde, superoxide dismutase and catalase activities using standard laboratory procedures.

Histomorphological Analysis

Pancreatic tissues were fixed in buffered formalin, processed using routine histological techniques, sectioned and stained with haematoxylin and eosin for microscopic examination.

Statistical Analysis

Data obtained were analyzed using statistical package for social science (SPSS) version 25. Data obtained were presented as mean ± standard error of mean. A one way ANOVA with Tukey's multiple comparisons test were used for the analysis. Significance was set at $p<0.05$*.

Results

Effects of Goko Cleanser on Hypothalamic Oxidative Stress Markers

Administration of Goko Cleanser produced observable changes in hypothalamic oxidative stress parameters when compared with the control group. There was an increase in lipid peroxidation, indicated by elevated malondialdehyde levels in the treated groups. Antioxidant enzyme activities, including superoxide dismutase and catalase, showed dose-dependent alterations following Goko Cleanser administration. These findings suggest that exposure to the herbal mixture affected the oxidative balance within the hypothalamic tissue.

Table 2: Mean ± SEM of Oxidative and inflammatory Markers of Hypothalamus tissue by group in adult Wistar rats

Groups	G1	G2	G3	G4	P-Value
SOD (u/mg)	33.46 ± 1.11	32.75 ± 1.21	33.71 ± 0.76	34.42 ± 0.45	0.69
CAT (u/mg)	9.14 ± 0.84	8.34 ± 0.66	10.57 ± 0.77	10.95 ± 0.26	0.55
MDA (Mmol/mg)	11.14 ± 0.43	11.14 ± 0.13	10.64 ± 0.80	10.25 ± 0.24	0.14
C-reactive Protein (u/l)	42.21 ± 0.76	42.88 ± 0.95	43.07 ± 0.00	41.22 ± 0.14	0.28

SOD= superoxide dismutase; MDA= Malondialdehyde; CAT= Catalase
G1-control group, G2- low dose group, G3-medium dose group, G4- high dose group

The result from the table above revealed that the value of the SOD from G1- G4 are 33.46 ± 1.11, 32.75 ± 1.21, 33.71 ± 0.76, and 34.42 ± 0.45 respectively. The value of G4 was higher followed by G3 and G1 then G2 but there was no significant increase across the groups. These values are within normal range. The values of CAT from G1- G4 are 9.14 ± 0.84, 8.34 ± 0.66, 10.57 ± 0.77, and 10.95 ± 0.26. The value of G3 and G4 were higher than G1 followed by G2. Although, there was no significant difference seen across groups. The values of MDA from G1- G4 are 11.14 ± 0.43, 11.14 ± 0.13, 10.64 ± 0.80 and 10.25 ± 0.24. The values for G1 and G2 are higher than the values of G3 and G4 but there was no significant different across the groups. The values for C-reactive protein from G1- G4 are 42.21 ± 0.76, 42.88 ± 0.95, 43.07 ± 0.00, 41.22 ± 0.14. Higher value was seen in G3 followed by G2, G1 and G4. There was no significant difference among them across the group.

Effects of Goko Cleanser on Pancreas

Table 3. Mean ± SEM of Blood Glucose Levels by Group

Groups	G1	G2	G3	G4	p-value
GLU (mg/dl)	80.67 ± 1.45	76.00 ± 3.06	80.67 ± 3.53	80.00 ± 5.29	0.76

GLU = glucose
***** = sig at p<0.001; ** = sig at p<0.01; * = sig at p<0.05**

The result from table 3 above revealed that the values of glucose from G1- G4 are 80.67 ± 1.45, 76.00 ± 3.06, 80.67 ± 3.53, 80.00 ± 5.29 respectively. The values are within normal range with that of G1 and G3 higher than G2 and G4. There was no significant different observed across group.

4.6. Mean ± SEM of Weight (kg) by Group

Groups	G1	G2	G3	G4	p-value
Day 1 (D1)	91.80 ± 3.44	129.00 ± 1.53 a***	146.00 ± 2.35 a***b**	168.20 ± 9.24 a**b*	<0.0001
Day 7 (D7)	118.80 ± 4.79	156.00 ± 0.45 a**	184.60 ± 1.78a*** b***	196.80 ± 10.89 a**	0.0001
Day 14 (D14)	138.60 ± 5.56	170.00 ± 2.75 a**	200.80 ± 5.42a*** b**	209.40 ± 11.51 a**	<0.0001
Day 21 (D21)	145.80 ± 3.84	176.60 ± 2.46 a**	203.80 ± 6.31a*** b*	214.20 ± 9.75 a**	0.0001

***** = sig at p<0.001; ** = sig at p<0.01; * = sig at p<0.05**

The result from the table above shows that the animals' body weight for D1 in G1-G4 are 91.80 ± 3.44, 129.00 ± 1.53 a***, 146.00 ± 2.35 a***b**, and 168.20 ± 9.24 a**b*. There was a statistically significant difference in G4, G3 and G2 with G1, and G4 and G3 with G2 between groups. The values of body's weight on D7 in G1-G4 are 118.80 ± 4.79, 156.00 ± 0.45 a**, 184.60 ± 1.78a*** b***, and 196.80 ± 10.89 a**. There was a statistically significant difference in G4, G3 and G2 with G1, and G3 with G2 between groups. The values of body's weight on D14 in G1-G4 are 138.60 ± 5.56, 170.00 ± 2.75 a**, 200.80 ± 5.42a*** b**, and 209.40 ± 11.51 a**. There was a progressive increase in the body's weight from D1 to D21. There was a statistically significant difference in G4, G3 and G2 with G1, and G3 with G2 between groups. A post hoc analysis revealed G3 was significantly higher than that of G2.

Histomorphological Findings of the Pancreas

Pancreatic sections from the control group showed normal histological features with intact acini and well-preserved islets of Langerhans. However, pancreatic tissues from Goko Cleanser–treated groups showed normal acinar but focal fatty changes in the connective tissue. These alterations appeared to increase with higher doses of Goko Cleanser.

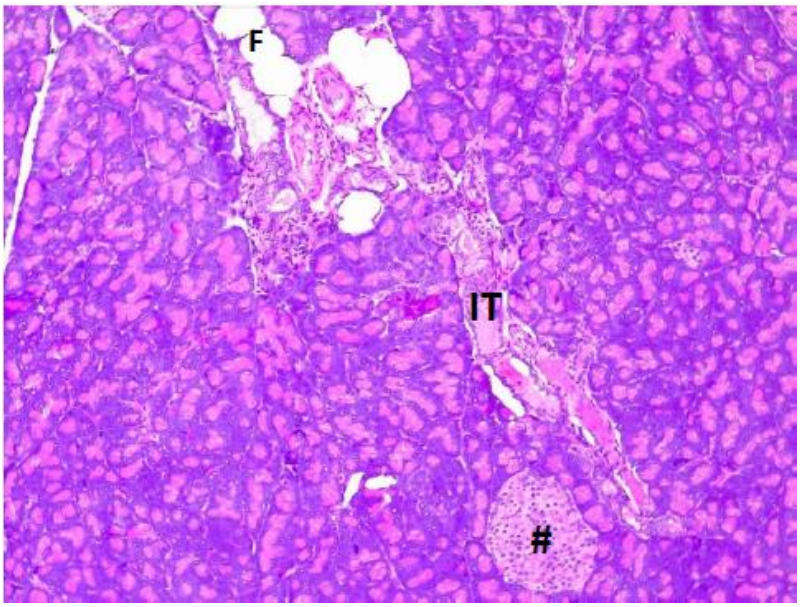

Plate 1: Photomicrograph of the pancreas in Group 1 (Control Group)

The photomicrograph of the pancreatic tissue from the control group demonstrates a well-preserved histological architecture. The exocrine portion of the pancreas, represented by the acinar cells (marked with an asterisk), appears normal, with serous acinar cells displaying basophilic staining at the basal region and acidophilic staining at the apical region, consistent with typical enzyme-secreting cells. The endocrine component, represented by the islets of Langerhans (indicated by #), is clearly identifiable and maintains its normal morphology, with well-demarcated cell clusters and uniform cellular distribution. Within the interlobular connective tissue septa, a focal area of fatty change (labeled F) is observed, suggesting minor lipid accumulation without overt tissue disruption. Overall, the histological features indicate that the pancreas in the control group retains normal structural integrity. The tissue was stained with hematoxylin and eosin (H & E) and examined at a magnification of ×100.

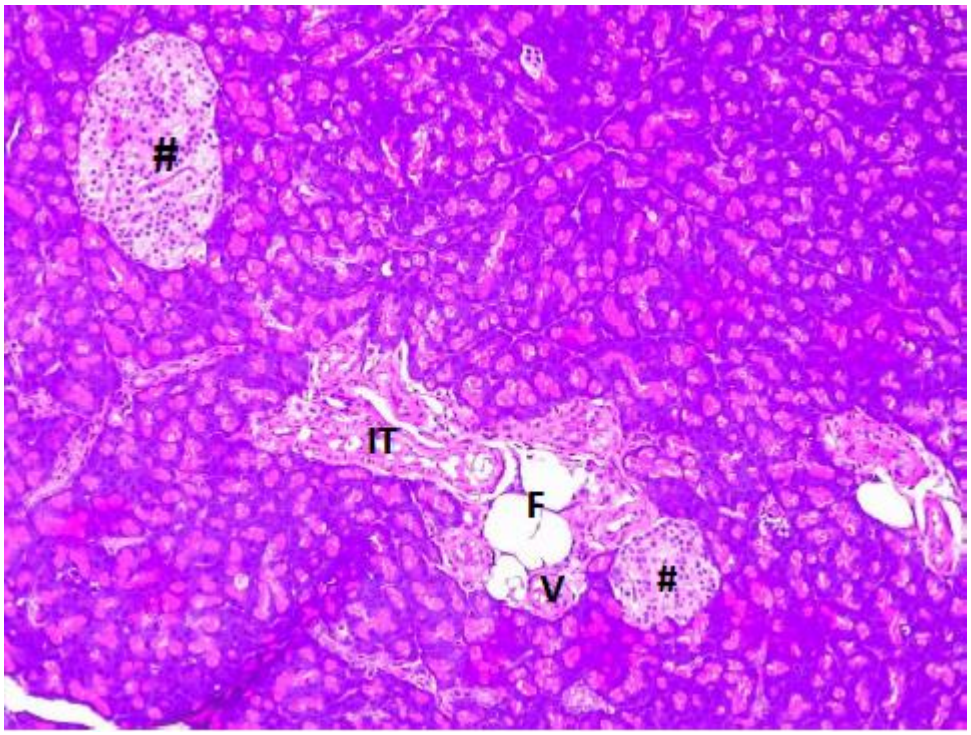

Plate 2: Photomicrograph of the pancreas in Group 2 (Low-Dose Group)

The photomicrograph of pancreatic tissue from the low-dose group demonstrates largely preserved histological architecture, comparable to the control. The exocrine portion of the pancreas, represented by acinar cells (asterisk), shows normal morphology with serous acinar cells exhibiting basophilic staining at the basal region and acidophilic staining at the apical region, consistent with typical enzyme-secreting cells. The endocrine component, represented by the Langerhans islets (indicated by #), remains intact with clearly demarcated cell clusters and uniform cellular distribution. A focal area of fatty change (labeled F) is visible within the interlobular connective tissue septa, indicating minor lipid deposition without disrupting the surrounding tissue. No observable lesions, necrosis, or inflammatory infiltrates were detected, suggesting that the low-dose administration did not induce structural pancreatic damage. The tissue was stained using hematoxylin and eosin (H&E) and examined at ×100 magnification.

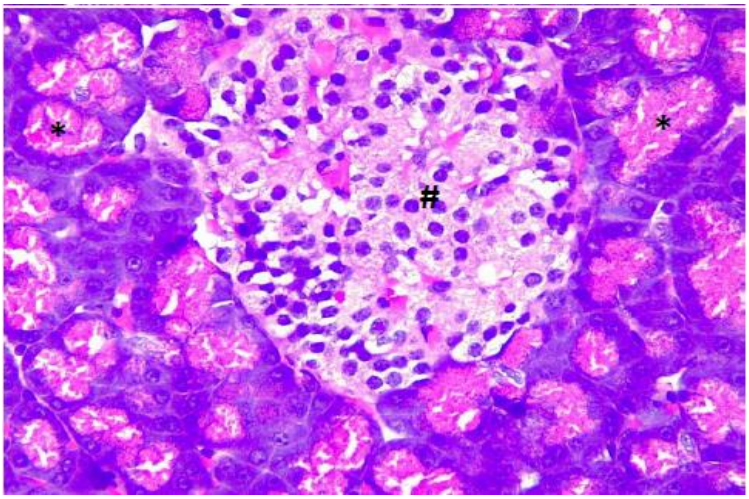

Plate 3: Photomicrograph of the pancreas in Group 3 (Medium-Dose Group)

The photomicrograph of pancreatic tissue from the medium-dose group shows preservation of the overall histoarchitecture of the organ. The exocrine pancreas, represented by the acinar cells (asterisk), displays normal morphology with serous acinar cells demonstrating basophilic staining at the basal region and acidophilic staining at the apical region, indicative of healthy enzyme-secreting cells. Multiple Langerhans islets (labeled #) are present, though they appear loosely packed with pale-staining cells, suggesting subtle alterations in the endocrine component without overt tissue damage. No necrosis, inflammatory infiltration, or lesions were observed, indicating that medium-dose exposure did not induce marked pathological changes. The tissue was stained with hematoxylin and eosin (H&E) and examined at ×400 magnification, providing detailed visualization of cellular morphology. These findings suggest that, while minor changes in islet cellular density may occur, the pancreas retains structural integrity at this dosage.

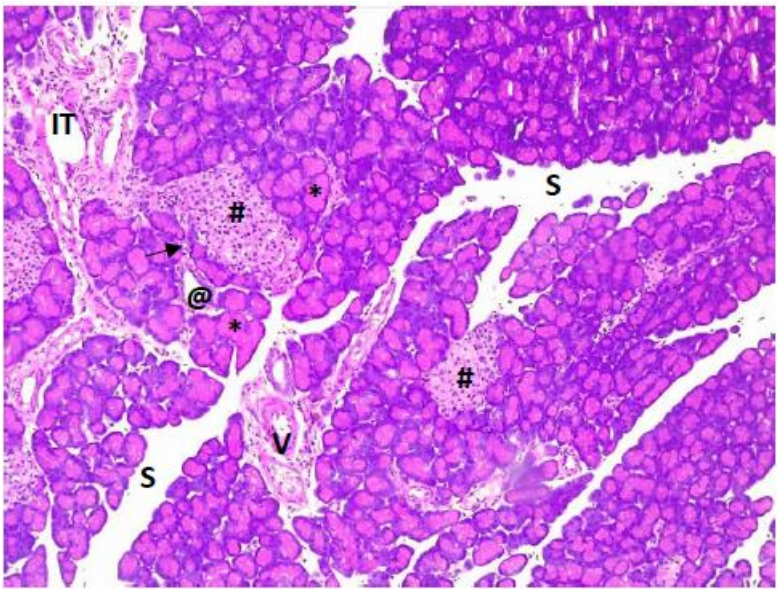

Plate 4: Photomicrograph of the pancreas in Group 4 (High-Dose Group)

The photomicrograph of pancreatic tissue from the high-dose group demonstrates preservation of the organ's general architecture. The exocrine pancreas, represented by acinar cells (asterisk), appears normal, with serous acinar cells displaying basophilic basal cytoplasm and acidophilic apical cytoplasm, indicating active enzyme production. Several Langerhans islets (#) are visible, showing loosely packed, pale-staining cells, suggesting mild changes in the endocrine component without overt cellular injury. Interlobular connective tissue septa (S) are intact, and the ductal system, including intralobular ducts (@) and intercalated ducts (arrow), is clearly delineated, showing normal morphology. No necrosis, inflammatory infiltration, or lesions were observed. The tissue was stained using hematoxylin and eosin (H&E) and examined at ×100 magnification, providing clear visualization of both exocrine and endocrine structures. These findings indicate that, even at high doses, the structural integrity of the pancreas remains largely preserved, although subtle changes in islet cell density may suggest a mild, dose-related effect on endocrine tissue.

Discussion

The findings of this study demonstrate that Goko Cleanser exerts measurable effects on hypothalamic oxidative stress markers and induces histomorphological changes in the pancreas of adult male Wistar rats. The results showed that superoxide dismutase (SOD) and catalase (CAT) activity levels were higher in the high-dose group compared to the control, while malondialdehyde (MDA) levels were lower in the medium- and high-dose groups compared to control and the same in the low-dose groups and the control. This pattern may suggest a possible adaptive antioxidant response, where the body attempts to counteract potential oxidative challenges induced by the herbal formulation (Halliwell & Gutteridge, 2015; Ighodaro & Akinloye, 2018). However, there were no significant differences in SOD, CAT, or MDA levels across the groups, indicating that these observed variations may not be strong enough to establish a clear toxicological effect. This implied that Goko Cleanser had no adverse effect on oxidative and inflammatory markers on the hypothalamus under the conditions of this study. These findings differ from previous studies by Oyagbemi et al. (2016) and Akinmoladun et al. (2007), who reported significant increases in MDA levels and reductions in SOD and CAT activities, suggesting oxidative stress and compromised antioxidant defense in treated animals. The differences observed may be attributed to variations in dosage, duration of exposure, or differences in experimental conditions.

The results showed that C-reactive protein (CRP) levels were highest in the medium-dose group (G3), followed by the low-dose group (G2), while the control group (G1) and high-dose group (G4) had lower levels, with G4 being lower than the control. C-reactive protein is a well-established biomarker of systemic inflammation, and elevated levels are often indicative of inflammatory responses (Pepys & Hirschfield, 2003; Sproston & Ashworth, 2018). However, these differences were not statistically significant, suggesting that the administration of Goko Cleanser did not provoke a pronounced inflammatory response in the experimental animals. This indicates that, within the duration and dosage used in this study, the herbal formulation may not significantly activate systemic inflammatory pathways. This finding contrasts with the report of Akinmoladun et al. (2007), who documented significant elevations in CRP levels following herbal exposure, suggesting that such formulations could trigger inflammatory responses. Such discrepancies may arise from differences in experimental design, duration of treatment, or sensitivity of the biomarkers assessed.

The results showed that glucose levels in groups 2 and 4 were lower compared to group 1, while group 3 had the same value as the control, with no significant differences observed across the groups. Glucose homeostasis is tightly regulated by the endocrine function of the pancreas, particularly through insulin and glucagon secretion (Betts et al., 2013; Hall, 2021). The absence of significant variation in glucose levels suggests that Goko Cleanser did not markedly disrupt glucose regulation in this study. This disagrees with the findings of Akinmoladun et al. (2007), who reported metabolic alterations following herbal exposure, indicating potential glycemic effects. Additionally, Yadav and Lowenfels (2013) reported increased serum amylase and lipase levels in pathological conditions, which are biochemical markers of pancreatic injury and may indicate the development of pancreatitis. The divergence in findings may reflect differences in dosage, duration of exposure, or individual physiological responses of the experimental animals.

Histological examination of the pancreas in this study revealed loosely packed, pale-staining islet cells, with normal acinar architecture but focal fatty changes in the connective tissue. These subtle structural alterations may indicate early or mild tissue responses to the herbal formulation without extensive cellular damage. The preservation of acinar cells suggests that the exocrine function of the pancreas may not have been severely compromised within the duration of the study. However, the presence of fatty changes may point to metabolic alterations within the pancreatic microenvironment (Tushuizen et al., 2007). These results disagree with Elufioye and Habtemariam (2019), who observed marked tissue damage associated with herbal toxicity. Similarly, Elufioye and Habtemariam (2019) reported structural disruptions that could impair both endocrine and exocrine functions of the pancreas. The comparatively milder findings in the present study may suggest that the toxic effects of Goko Cleanser on pancreatic tissue are dose- and duration-dependent, becoming more pronounced with prolonged exposure or higher concentrations.

The study showed a steady increase in animal body weight from day 1 to day 21, with a sharp rise between day 1 and day 7. Body weight changes are often used as general indicators of health status and metabolic function in experimental animals (Organisation for Economic Co-operation and Development (OECD, 2008). The observed weight gain may suggest that the animals maintained adequate nutritional intake and were not subjected to severe systemic toxicity during the study period. The weight gain was statistically significant, aligning with Akinmoladun et al. (2007), who suggested that herbal formulations may influence metabolism and energy utilization, potentially contributing to weight gain. However, this contradicts the findings of Morton et al. (2014), who reported that hypothalamic mechanisms can suppress appetite, leading to reduced food intake and weight loss. These conflicting outcomes highlight the complexity of the herbal formulation's effects and suggest that its impact on body weight may depend on multiple factors, including dosage, duration of exposure, and individual metabolic responses.

Conclusion

This study concludes that Goko Cleanser exerts measurable effects on the hypothalamus and pancreas, with evidence of oxidative stress in the hypothalamus and histomorphological alterations in pancreatic tissue of adult male Wistar rats. Although the antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT) did not show statistically significant reductions, the subtle trends observed may indicate early adaptive responses to oxidative

challenges induced by prolonged exposure to the herbal mixture. In the pancreas, the structural changes, including loosely packed and pale-staining Langerhans islet cells and mild fatty changes within the interlobular connective tissue, suggest potential disruption of both endocrine and exocrine functions. Such alterations, if persistent, could impair glucose homeostasis, insulin secretion, and digestive enzyme production, which are critical for maintaining metabolic balance.

These findings highlight that even herbal formulations perceived as safe, like Goko Cleanser, may have organ-specific effects when administered over extended periods or at higher doses. The structural modifications observed in pancreatic tissue, though mild in this study, point to the possibility of cumulative metabolic consequences over time. This is particularly relevant in the context of polyherbal formulations, where the synergistic interactions between multiple plant constituents may enhance biological activity but also increase the potential for toxicity. Moreover, while oxidative stress markers in the hypothalamus did not reach statistical significance, their measurement underscores the importance of monitoring central nervous system responses, as the hypothalamus plays a pivotal role in regulating appetite, energy metabolism, and endocrine function.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Consumers should exercise caution in the prolonged use of Goko Cleanser due to its potential neurotoxic and pancreatic effects.
2. Regulatory agencies should enforce quality control and safety evaluation of herbal formulations before widespread distribution.
3. Further studies should be conducted to evaluate the long-term effects of Goko Cleanser on other brain regions and endocrine organs.
4. Public awareness should be increased regarding the possible adverse effects of indiscriminate consumption of herbal mixtures.

DECLARATION

The products used for this research are predominantly used products in our area of research and country. There is no conflict of interest in any way between the authors and producers of the products. We do not intend to use these products as an avenue for litigation but for learning and advancement of knowledge. It is of interest to note that, the research was not funded by the producing company but was funded by personal efforts of the authors.

DISCLAIMER

Some part of this manuscript was previously presented and published in……

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