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Original Research Article

Comparative Assessment of the Effects of Consumption of Ginger and Marijuana on Learning and Memory in Swiss Mice

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Abstract

A plethora of medicinal plants have been shown to improve memory, cognition, and intelligence. *Zingiber officinale (Ginger)* and *Cannabis sativa* (Marijuana) have been shown to affect memory, cognition, and intelligence too. This study aimed at comparing the effects of *Zingiber officinale* and *Cannabis sativa* on learning and memory was carried out in Swiss mice. The mice were randomly divided into 3 groups of 15 animals each. Group 1 (control) were fed mice feed. Group 2 (ginger group) were fed with a ginger-laced diet containing ginger and mice feed at a percentage ratio of 5:95. Group 3 (marijuana group) were fed with a marijuana-laced diet containing marijuana and mice feed at the percentage ratio of 5:95. All mice were fed for 14 days and given water to drink daily. Daily food and water intake were recorded. The mice were evaluated for learning and spatial memory using novel object recognition tests and data obtained were subjected to ANOVA and T test respectively. The result showed that the *Zingiber officinale* group showed significantly better memory as seen by an increase in the recognition index when compared to the other groups. This shows that *Zingiber officinale* shows positive effects on cognition than *Cannabis sativa* at the same dose.

Keywords: *Zingiber officinale* (Ginger), *Cannabis sativa* (Marijuana), learning, memory.

INTRODUCTION

Traditional herbal treatments have been utilized all over the world to improve memory loss and related conditions. A plethora of medicinal plants have been shown to improve memory, cognition, and intelligence (Jivad & Rabiei, 2014).

The plant *Zingiber officinale* (Ginger), belongs to the Zingiberaceae family and its thick tuberous rhizomes are used as medicinal plant, spice, and additive agent for flavouring foods and drinks. Arabian mythology claims that ginger can improve memory (Saenghong *et al*., 2012). In the cerebral cortex and hippocampus, *Zingiber officinale* has been shown to increase the levels of norepinephrine, epinephrine, dopamine, and serotonin (Waggas, 2009). Additionally, the active constituent, 6-gingerol reduced cholinesterase activity which led to an increase in acetylcholine (ACh), a neurotransmitter that is crucial for learning and memory (Saenghong *et al*., 2012).

Marijuana is a blend of dried *Cannabis sativa* flowers that is greenish-grey in color and is known for its use as a medicinal plant as well as a recreational and entheogenic drug for centuries (Lee CM, Neighbours C, Woods BA, 2007). The toxicity of cannabis usage has been linked to a variety of complex psycho-cognitive impairments, including learning and memory, mood, planning, and other executive processes (Imam *et al*., 2016). Heavy marijuana usage appears to be especially harmful to the hippocampus (Filbey, McQueeny, Kadamangudi, Bice, & Ketcherside, 2015). Marijuana contains several components which among other effects may alter hippocampal function, the brain area responsible for memory formation. Despite the challenges of the abuse of marijuana, there is some medicinal importance attached to it's prescribed usage, as controlled use for medicinal purposes is legalized in some countries (Imam *et al.*, 2016).

Today, thousands of young people including students around the world make use of plants like *Zingiber officinale* and *Cannabis sativa* as part of their everyday lives (Garner, 2016). It is important to know the effects that *Zingiber officinale* and *Cannabis sativa* have on normal neural functions. Thus, the purpose of this study is to compare the effects of Ginger (*Zingiber*

officinale) and Marijuana (*Cannabis sativa*) on the learning and memory of Swiss mice.

MATERIALS AND METHODS

Preparation of cannabis sativa

The leaves of the *Cannabis sativa* plant were obtained from the National Drug Law Enforcement Agency (NDLEA) in Rivers State, Nigeria, and they were dried, blended to powdery particles, and weighed. Ethical approval was obtained from the ethical committee of Rivers State University, Nigeria.

Preparation of Ginger (Zingiber officinale)

The rhizomes of *Zingiber officinale* were purchased from mile 3 market, Port Harcourt, Rivers State. Nigeria. It was washed, peeled, chopped into smaller sizes, and dried. The dried ginger was then ground in a manual grinding machine into powder form.

Animal care

The animals used for this study were kept in the animal house of the Faculty of Basic Medical Sciences, Rivers State University, Nigeria, in a cage. Food and water were administered *ad libitum* under standard laboratory conditions and a 12 hour light-dark cycle. All experimental procedures were performed in accordance with standard guidelines on the use and care of laboratory animals.

Treatment schedule

The rats were randomly distributed into three (3) groups (n = 15) as follows:

Group 1 (control): were fed normal feed and served as the control group.

Group 2 (ginger group): were fed with a ginger-laced diet containing ginger and mice feed in the ratio of 5:95.

Group 3 (marijuana group): were fed with a marijuana-laced diet containing marijuana and mice feed in the ratio of 5:95.

All mice were fed for 14 days and given water to drink daily. Daily food and water intake were recorded. All procedures were scheduled and carried out during the light phase between 9:00 and 15:00

Behavioural evaluations

The rats were evaluated for learning and spatial memory using novel object recognition tests.

The Object Recognition Test

The Novel Object Recognition procedure consists of three phases: habituation, familiarization, and test phase. After a retention interval, during the test phase, the animal is returned to the open-field arena with two objects, one is identical to the sample and the other is novel (Ennaceur, 2010).

Statistical Analysis

The data was analysed using the software; Statistical Package for Social Sciences version 25. One-way analysis of variance (ANOVA) was used to determine the mean and Turkey's HSD test was employed for multiple comparisons within and between groups. A P-value of <0.05 was considered statistically significant in all cases and the result presented as mean ± standard error of the mean.

RESULTS

The results are presented in Figures 1-4.

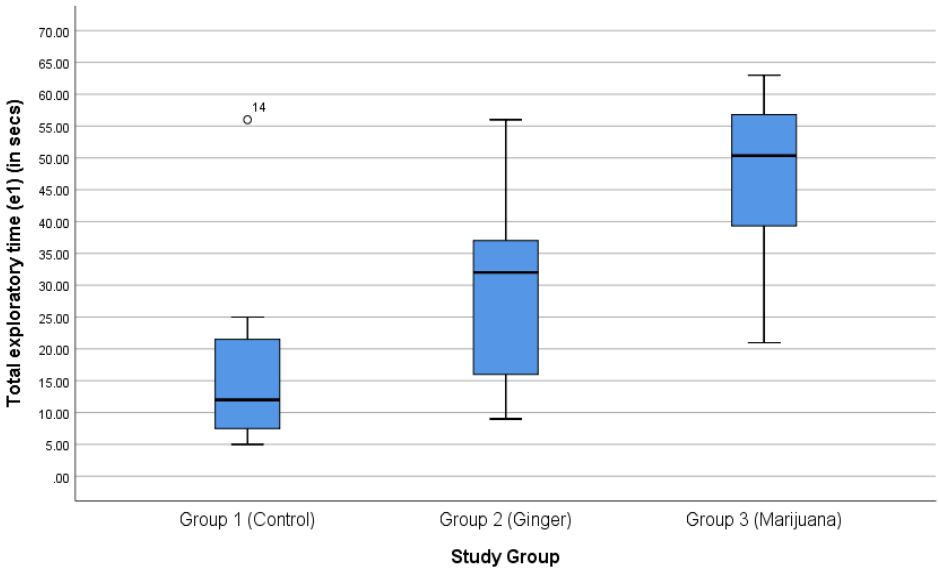

Figure 1: A box plot showing the effect of *Zingiber officinale* and *Cannabis sativa* total exploratory time (e1) parameters during the training day

Tukey's HSD Test for multiple comparisons found that the mean value of the total exploratory time was significantly different between groups 1 and 3. *($p<0.05$).

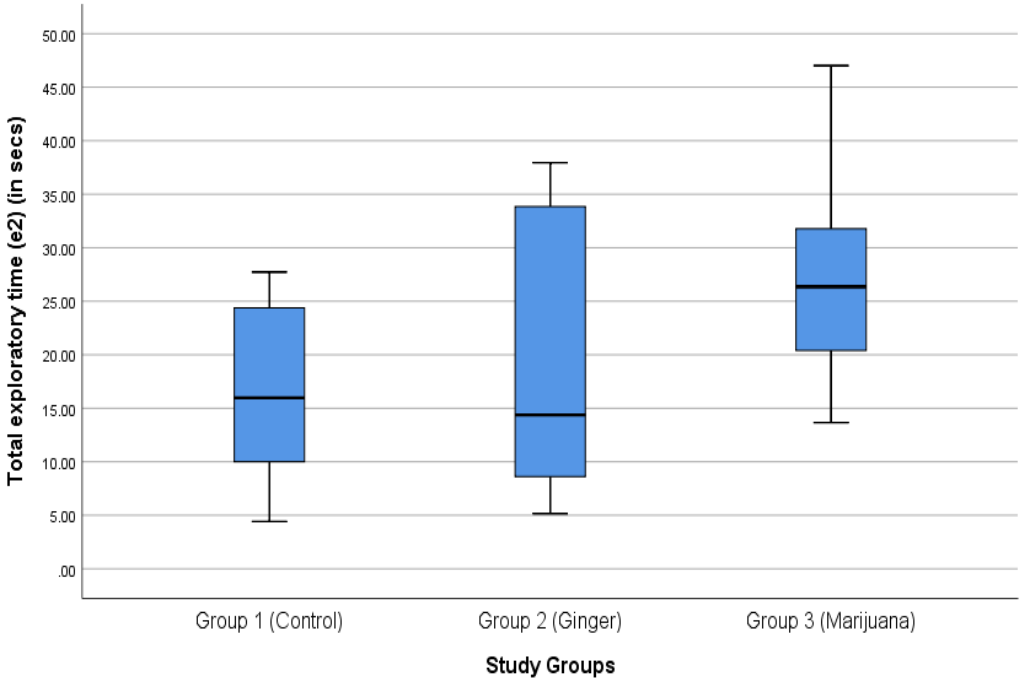

Figure 2: A box plot showing the effect of *Zingiber officinale* and *Cannabis sativa* on the total exploratory time (e2) parameters during the testing day

This revealed that there was no statistically significant difference between at least two groups in the time spent by each group exploring the familiar object (a) and the novel object (b).

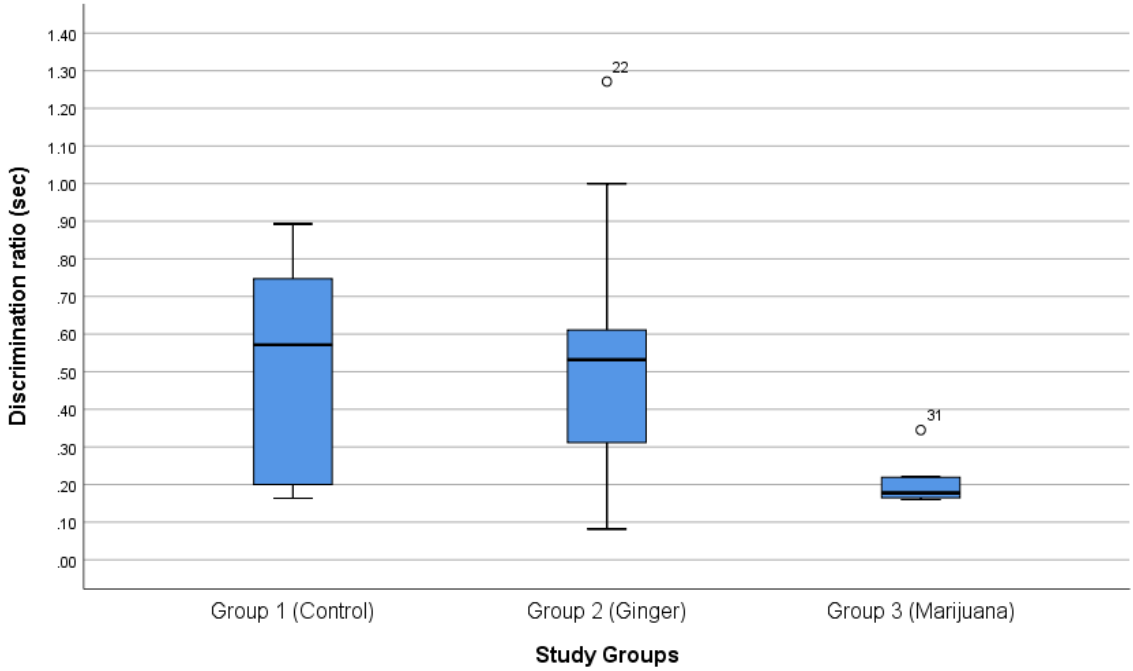

Figure 3: A box plot showing the effect of *Zingiber officinale* and *Cannabis sativa* on the discrimination ratio

A Turkey's HSD Post Hoc Test for Multiple comparisons also found that the mean value of the Discrimination ratio was significantly different between groups 1 and 3 as well as groups 2 and 3.*$p<0.05$

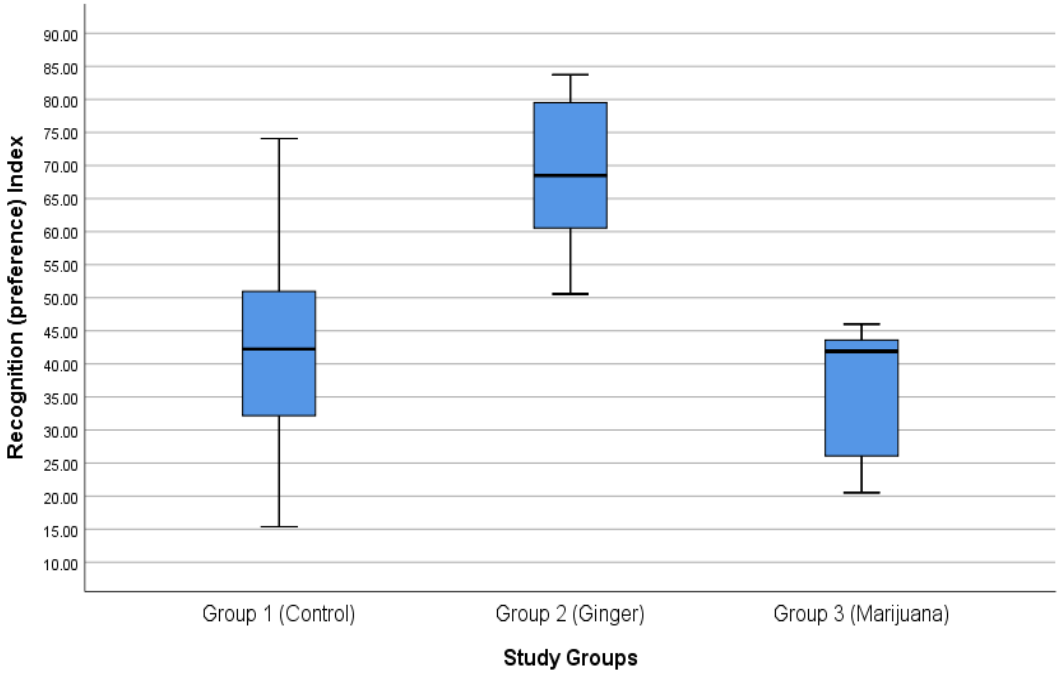

Figure 4: A box plot showing the effect of *Zingiber officinale* and *Cannabis sativa* on the Recognition index

A Turkey's HSD Post Hoc Test for Multiple comparisons also found that the mean value of the Recognition index was significantly different between groups 1 and 2 as well as groups 2 and 3.

DISCUSSION

Studies have shown the cognition enhancing effect of *Zingiber officinale* on memory and also evidence concerning the acute impairments in memory function induced by *Zingiber officinale* and *Cannabis sativa* (Bhattacharyya & Schoeler, 2013; Gomar, Hosseini, & Mirazi, 2014)**.** This study used the Novel Object Recognition test to measure exploration, memory, and object recognition in animals.

The *Zingiber officinale* group (Group 2) spent less time with the familiar object but more time with the novel object. This shows that this group learned and was able to recall (memory), therefore the process of learning and memory in this group is well-functioning. The *Zingiber officinale* group also showed significantly better memory, as seen by an increase in the recognition index when compared to the other 2 groups. This agrees with studies that showed that ginger enhanced learning and memory (Arcusa *et al.*, 2022; Gomar *et al.*, 2014; Saenghong *et al.*, 2012).*Zingiber officinale* has been shown to increase the level of epinephrine, norepinephrine, dopamine, and serotonin contents in the hippocampus and cerebral cortex, as well as acetylcholine, a neurotransmitter that plays an important role in learning and memory which is increased via the inhibition of the cholinesterase action.

The *Cannabis sativa* group (Group 3) spent more time exploring the familiar object even after spending so much time on it the previous day. This proves that even after several seconds of learning the previous day, they were unable to recall. This also agrees with previous studies (Bhattacharyya & Schoeler, 2013; Imam *et al.*, 2016; Okon, Obembe, Ofutet, & Osim, 2015) that showed that in both animals and humans, marijuana impairs memory and learning. Several studies suggest that its effect on memory and learning might be due to the main active component in *Cannabis sativa*, delta 9-tetrahydrocannabinol (THC). Memory impairment from marijuana use occurs because THC alters the hippocampus, a brain area responsible for the formation of memory. Despite the challenges associated with the use of marijuana including abuse, there is some medicinal benefits associated with a controlled and regulated use as it has found usefulness in the management of certain conditions such as cancer, pain and inflammation (Imam *et al.*, 2016).

However, the mechanism of neurocognitive and neurochemical processes underpinning the effects of marijuana on memory has not yet been fully understood (Bhattacharyya & Schoeler, 2013; Okon *et al.*, 2015).

CONCLUSION

This study shows that diet mixed at a dose of 95g of normal feed: 5g of *Zingiber officinale* shows positive effects on learning and memory while *Cannabis sativa* at the same dose has a negative impact on learning and memory.

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