The Influence of Chronic Plantain Meal Consumption on Exploratory, Locomotory and Weight Dynamic in Experimental Mice Model

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Abstract
The effect of consuming plantain diet chronically on some Neurobehaviour parameters was investigated in mice that weighted between 20.2kg –27.4kg. A random selection was made for mice categorized into three (3), such that two categories were allowed to consume either reduced (MD) or increased (PD) quantity of plantain meal, while one category had normal mouse feed; all under normal regulated condition of temperature and light/dark hours during the 30 days design of the experiment. Neurobehaviour parameters studied were exploration and locomotion activities alongside weight dynamics. After neurobehaviour studies, animals are euthanized, brain homogenates was analyzed to determine 5-HT quantity. The results obtained indicates differential food consumption rate ($p<0.05$) for all categories of animals; highest in control, followed by MD and PD category. There was increased ($p<0.05$) drinking rate for PD mice than control, but did not vary between MD vs. control. The body weight dynamic for the PD mice is increased ($p<0.05$) than those of MD categories with control. The frequencies at which they crossed lines, climbed wall and rear in air decreased ($p<0.05$) for MD , PD categories than control. 5-HT concentration was significantly ($p<0.001$) higher in the PD than MD and control categories. These observations imply an increased weight dynamic in MD and PD categories of mice. They also exhibited greater propensity for drinking water, but decreased exploratory with locomotory tendencies; probably not unconnected with 5-HT.

Keywords: *Plantain; Neurobehaviour, weight; Locomotory; Exploratory, 5-HT*

Introduction

Weight dynamic has in recent time become a veritable parameter that amongst several other vital sizes (measurable physiological indices) is considered an indicator of wellness or otherwise regarding health status [1]. It is also perhaps somewhat misconstruing to adjudge socio – economic status by indication of this dynamic - that may largely be as a result of elevated fluids level inside the body, increased mass of muscles and deposits of fat, [1]; associated with factors such as quality of food, amount of derivable energy from its metabolism, alongside the biological age and quality of life of individuals [1,2]. Moreover, it is arguable that socio-cultural, socio-economic and educational enlightenment of individuals may influence their choice of diet, and that the effects this may have on weight dynamic could differ widely [2].

When there is loss in weight, whether sudden or over time, health status is queried, particularly because excess weight loss (more than 1kg lost in weight weekly over a period) might be associated with severely depleted muscle, bone mass and energy drop [2], as well as other dysfunction that may be a pointer to severe clinical conditions not limited to diabetes and cancer [2].

On the other hand, when weight is gained, this may not be unconnected with “high proportions of fat, muscle mass, fluids of the body or sometimes, conspicuous enlargement in breast and stomach” [3]. There is growing awareness that choices of food do not only provide needed nourishment for the body, but could also predispose people to diseases, when there is resultant elevation of adipose deposits in the body than required optimal /healthy level [3]. Although some factors such as hereditary, medical conditions, conventional medications, hard drugs, and disabilities can affect weight gain, “it is now common knowledge that leading a sedentary lifestyle can be directly linked with fat-related weight or the diet consumed particularly depending on its frequency, type, and quantum per time or sometimes both dietary and sedentary factors” [4].

Whenever there is intake of calorie/ energy over and above the measure of expended energy, the body will usually attempt to address this imbalance by storing the excess calorie as fat. In this process, high-energy form of about three thousand five hundred calories would have been reserved or conserved. Therefore, in the long run, excessive intake of energy, lack of exercise or either of them may add to the process of fat gain tending to obesity [5]. Meanwhile, people who desire to monitor or particularly reduce weight would usually resort to exercising. But there is no doubt that this requires sufficient awareness/ scientific knowledge [6]. Because despite exercise routine to monitor weight gain, the impact of dietary choice is such that some food may enhance weight gain margin either less or more rapidly than others. Appropriately sustaining a limit of weight change either in upward or downward inclination is pivotal to a healthy life and in this report, we consider plantain which is vastly resourceful to humans – “for nutrition, medicine and industrial use” [7]. A few of our earlier studies had reported the effects of long-term consumption of plantain meal in cognitive behaviour improvement, reduction of anxious, apprehension feelings, and elevation of brain levels of 5-HT[8, 9]. The objective of this investigation was to study how feeding on plantain for long duration can affect weight, exploration and locomotory Neurobehaviour in mice.

Methodology

Thirty random adult Swiss mice of 20.2 kg to 27.4 kg weight, kept singly in standard cages were allowed in a properly ventilated animal room, under regulated laboratory condition with 14 days acclimatization; during which they all had free access to mouse chow and clean drinking water [10].

The peels of plantain bunch duly identified as musa paradisiaca were removed from the pulp which was washed, and chopped to slices that were dried at 40˚C and 55% humidity for 24 h in oven, then grinded into powder in a grinding mill [10]. This was designated as the PD - plantain diet or increased quantity of plantain meal. Equal amount of plantain flour and rodent chow mixed made up the MD – mixed diet or reduced quantity of plantain meal.

Electronic weighting balance was used to weight measured quantity of food in a container daily; such that the food weight was obtained by deducting weight of empty container from that of the food filled container. A sensitive electronic scale was used to monitor weight change at every three day interval. water intake was measured by deducting the quantity of remnant water from served water, using clean syringe to measure.

Swift nature of mice and human fatigue necessitated video- recording the entire experimentation for accurate capturing of exploration, locomotion and anxiety parameters [11],[12] during which each mouse's number was indicated before testing.

Standard established High Performance Liquid Chromatography method as applied by Mosienko *et al*, [11] and previously adopted by [13] was used to measure brains' 5-HT of all mice.

Statistical Analysis
All data were collated and statistical analysis (using ANOVA) as well as least significant difference test was applied, with results illustrated in mean ± SEM (standard error of mean), bar charts/graph with the reduced plantain (mixed diet - MD) and increased quantity (plantain diet – PD) Groups.

Results
The change in body weight among the three groups of mice in this study is shown both in tabular form and figure presentation as appropriate. From Table 1, all animals' weight appreciated, as represented by cumulative as well as initial and final. The daily food and water intake did not increase or decrease consistently, as captured in the non-linear nature of the graph for moving averages (see figure 1 and 2). The order of feeding rate compared was top to least; control > MD > PD (figure 3). But water drinking was higher in PD than MD and control (figure 4). Meanwhile, comparing the dynamics in weight (figure 4), PD had more than MD and control ($p<0.05$). Finally, comparing serotonin in groups of animals indicate elevated brains' serotonin of PD than MD and control.

Discussion and Conclusion
Summarily, an extent of regulatory function over food consumption and drinking is ascribed to hypothalamus [14]. However, consumption and drinking behaviour /rate could signify health condition [14]. This research reveals PD mice eating the least < MD < control in order of ascension and for drinking it was control < MD < PD. Probably these PD animals were not familiar with the introduced (plantain) meal; and it is either that the meal triggered satiety in them or elevated 5-HT

may be implicated for appetite depreciation [15]. Meanwhile, observed trend in weight dynamic may be as a result of nutritional component of PD meal and their increased water drinking rate.

Additionally, it is perhaps explainable that decreased PD rodents' exploration and locomotory behaviour (sedentary disposition) contributes to more weight gain; especially with elevated ($p<0.001$) PD group's brain 5-HT; wherein, it supports study by Foy and Parrat which relates plantain's composition of serotonin precursors [10], and Spaeth *et al*; Stahl *et al*, showing 5-HT overriding role over dopamine and nor adrenalin in sleep mechanism [16, 17].

In conclusion, weight dynamic, exploration and locomotory phenomena have neurobehaviour interconnection or component; such that only one of these may not solely be responsible for occurrences ascribed it. Hence pursuance of weight control for health or aesthetic reason should always be considered holistically.

Table 1: Weight Dynamics Measurement.

	Mean Initial Body Weight	**Mean Final Body Weight**	**Cumulative Mean Body Weight ± SEM**	**Mean Weight Change ± SEM**
Control	27.37	30.51	29.85 ± 0.31	3.14 ± 0.31
MD	26.48	29.59	27.95 ± 0.30	3.11 ± 0.30
PD	20.21	25.11	21.68 ± 0.63	4.90 ± 0.63

Figures

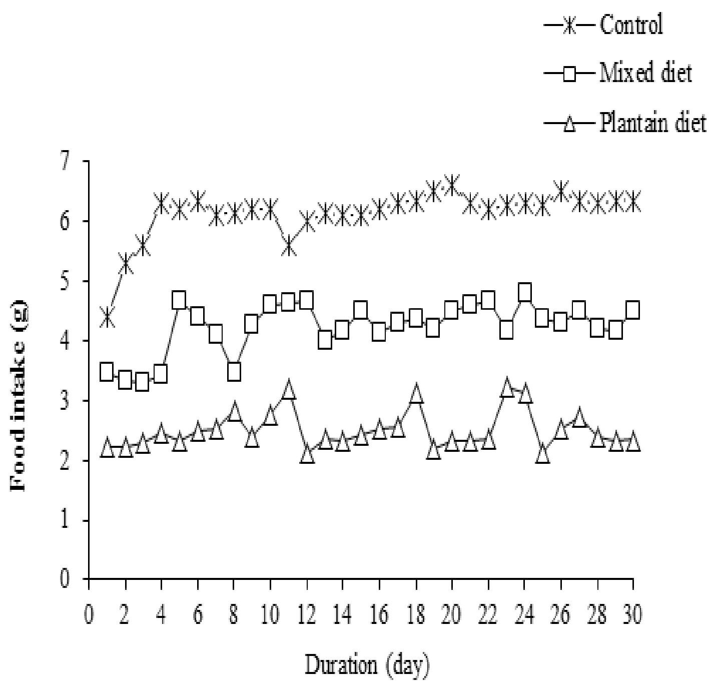

Figure 1: Food consumption Moving averages.

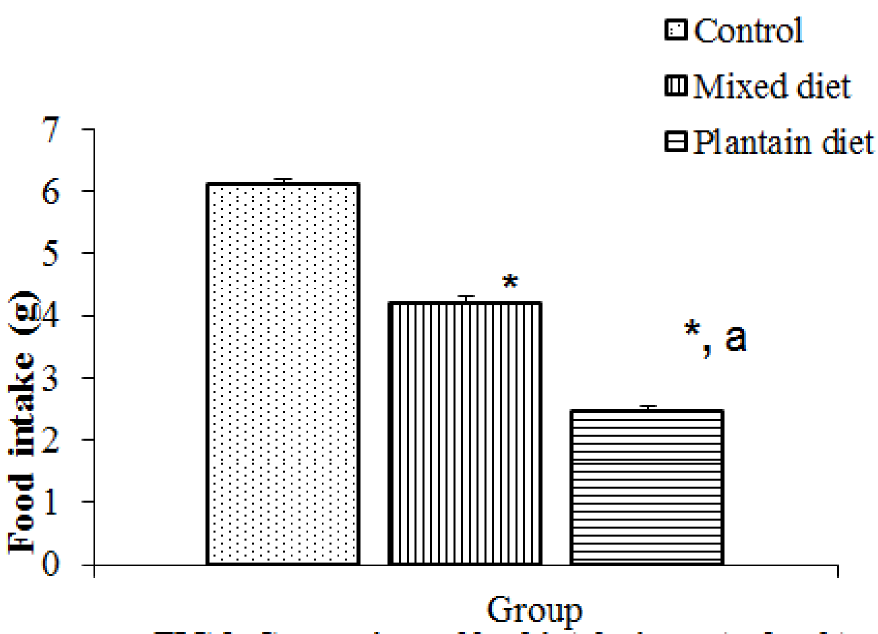

Figure 2: Food consumption comparison. Significance: *p<0.05 vs. control; a= p<0.05 vs. MD.

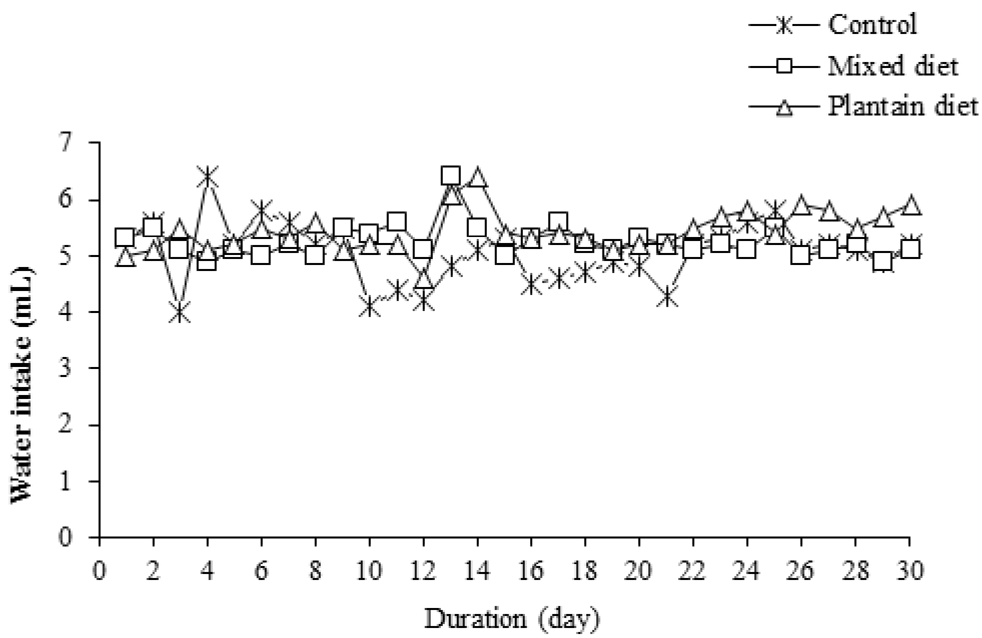

Figure 3: Water drinking Moving averages in mean + SEM.

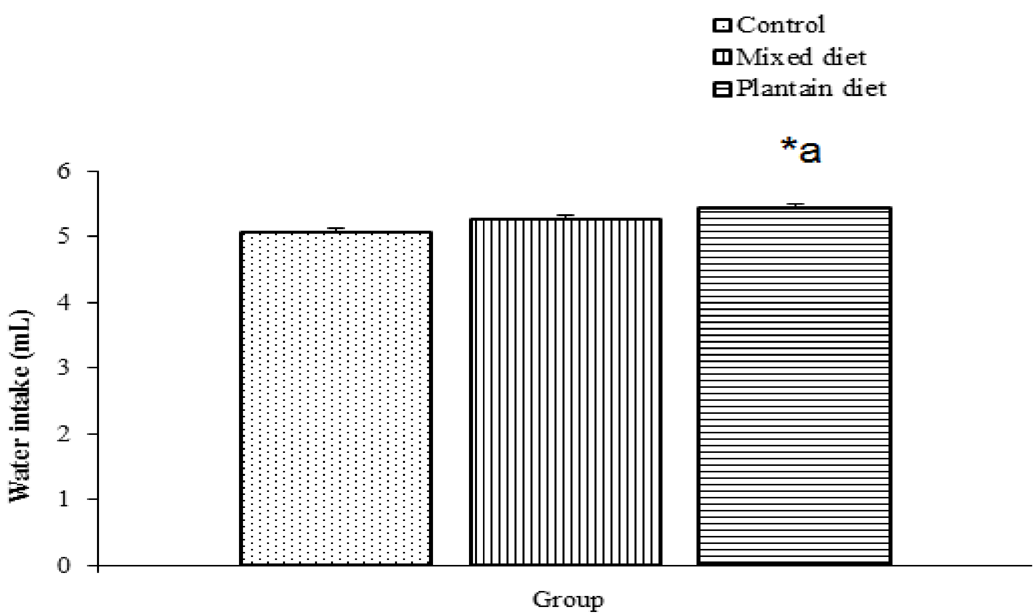

Figure 4: Water drinking comparison. Significance: *p<0.05 vs. control; a= p<0.05 vs. MD.

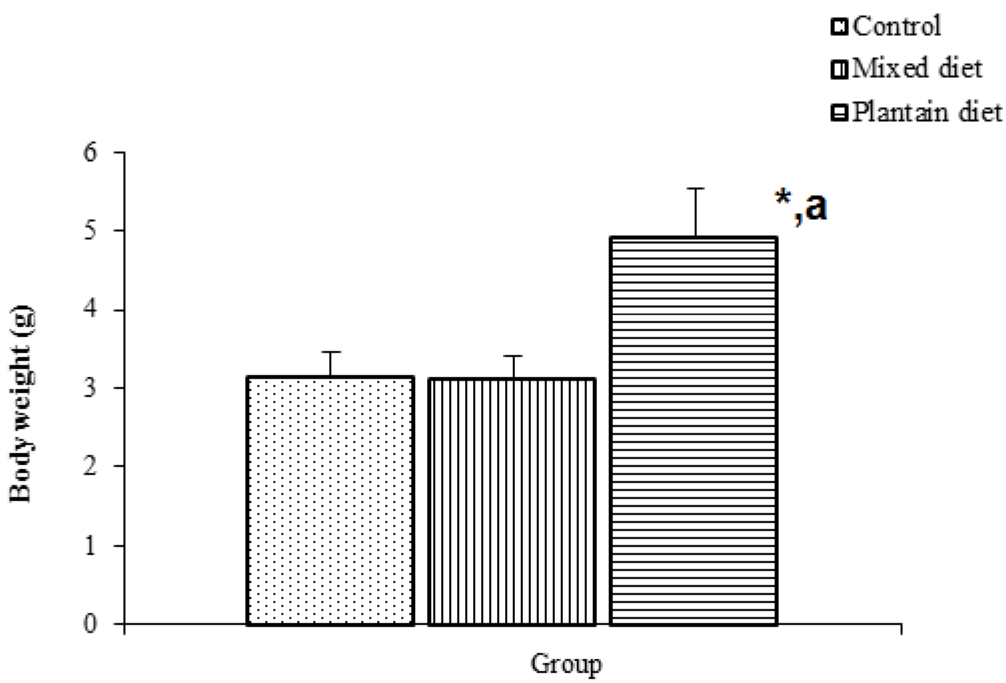

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Figure 5: Weight Dynamic Comparison Significance: *p<0.05 vs. control; a= p<0.05 vs. MD.

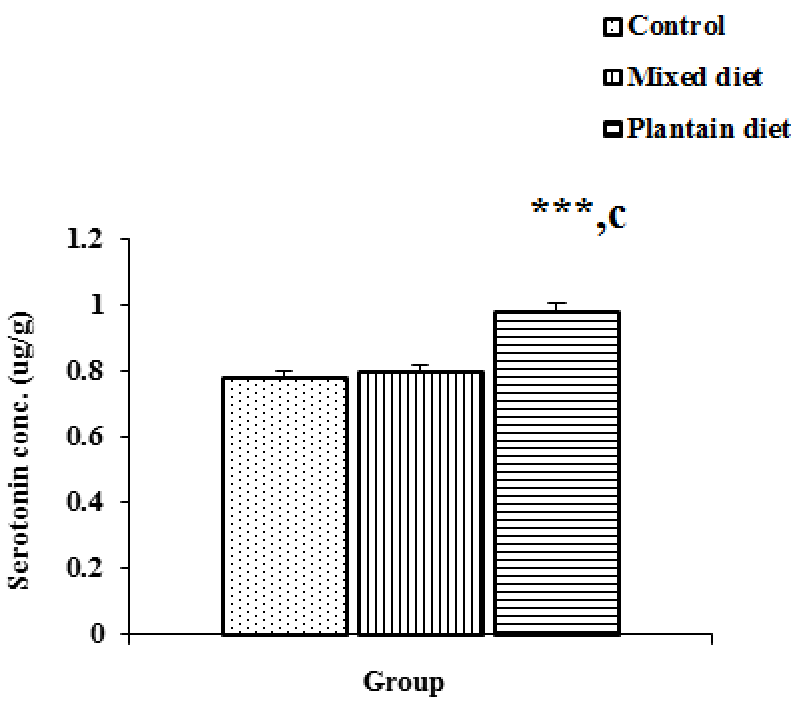

Figure 6: Brain serotonin Comparison in mean + SEM. Significance: ***p<0.001 vs. control; c= p<0.001 vs. MD

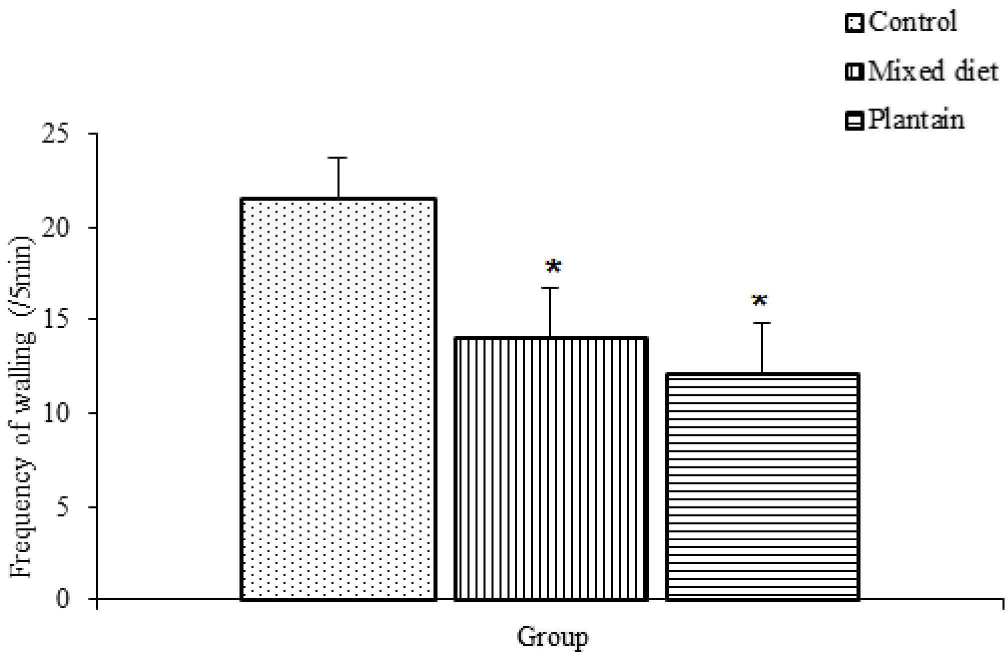

Figure 7: line crossing frequencies compared in the open field maze test n=9. Significance: *p<0.05 vs. control

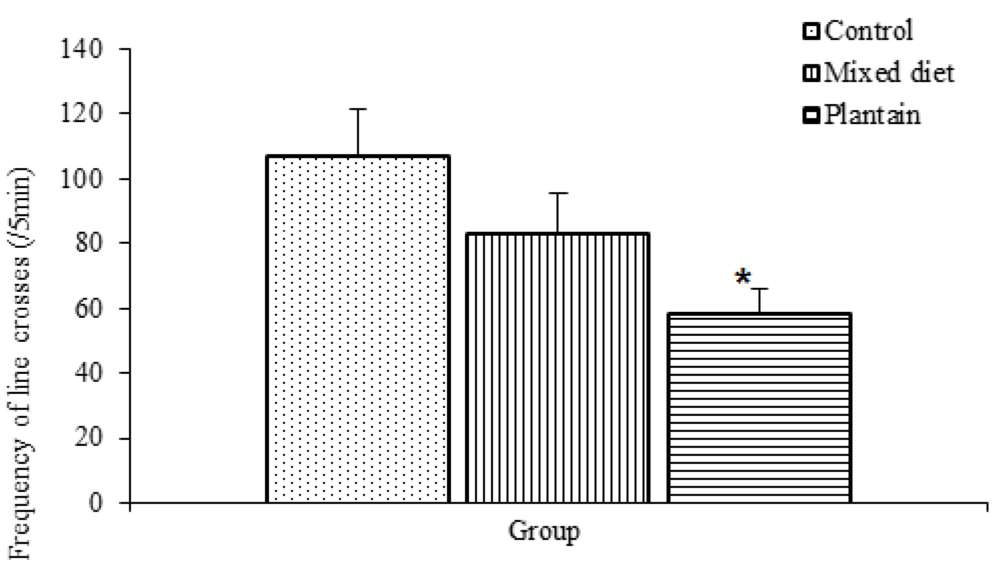

Figure 8: Walling frequencies compared in the open field maze test n=9. Significance: *p<0.05 vs. control.

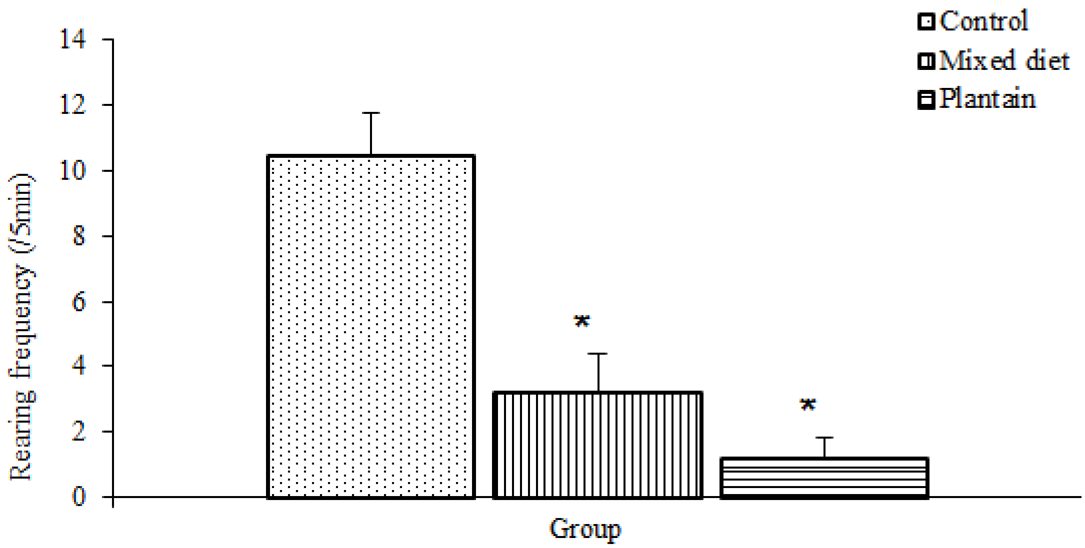

Figure 9: Rearing frequencies compared in open field maze test n= 9. Significance *p<0.05 vs. control

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