INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com ISSN : 0976-4550

Volume-7, Issue-2, April-June-2016 Coden IJABFP-CAS-USA Copyrights@2016

Received: 15th Jan 2016 *Revised: 22nd Feb 2016* *Accepted: 22nd Feb 2016*

Research article

THE COMPARATIVE EFFECT OF BEER AND PALM WINE ON LEARNING AND MEMORY IN MICE

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ABSTRACT

Background: Beer and palm wine are two alcoholic beverages that play an important role in local ceremonies and other social life of Nigerians especially in the Southern part of Nigeria. Palm wine contains bioactive compounds which have a stimulating effect on the nervous system.

Aim: This study was set to ascertain if palm wine and beer (alcoholic beverages) could affect learning and memory

Methodology: Twenty-five Swiss white mice were randomly assigned into five groups, viz; control, palm wine-treated (1 ml and 2 ml) groups respectively; beer-treated (1 ml and 2 ml) groups respectively. After 28 days of treatment, the Morris water maze was used to assess learning and memory

Results: The overall performance in the Morris water showed that the palm wine treated group had better performance during the acquisition and reversal training which shows better learning ability and memory retention. This was however not statistically different from the beer treated group. Similar trend was observed in probe/retention trial test.

Conclusion: Palm wine treated mice had better learning and memory ability when compared to beer-treated mice. It is possible that the bioactive compounds present in palm wine had a more stimulating effect on the nervous system hence better performance in learning and memory as compared to beer treated mice.

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INTRODUCTION

Palm wine and beer are two alcoholic beverages that have gained a lot of cultural interest with high consumption rate among the educated and non-educated in Nigerian society (Akachukwu CO, 2001). The existing belief that these two beverages are alcoholic stimulated our interest in comparing their effects on learning and memory.

Palm wine is often infused with medicinal herbs to remedy a wide variety of physical complaints. As a token of regard and respect to the deceased ancestors, many drinking sessions in Igbo land begin with small amount of palm wine spilled on the ground as a libation to appease the gods (Akachukwu CO, 2001).

The raffia-palm (Raphia hookeri Mann and Wendl) exhibited a wide range of biological and pharmacological activities such as anti-inflammatory (Roger GDP, 2002), diuretic, laxative, antispasmodics (Okwu DE, 2004), anti-hypertensive and antimicrobial function. These functions are performed due to the chemical constituents comprising sugars, lipids, protein, vitamins, minerals and phytochemicals.

Beer is an enjoyable refreshing drink with relatively low alcohol strength compared to other alcoholic drinks per volume, made from malted barley, cereals, hops, yeast and water. Beer has essential vitamins (particularly B vitamins), minerals and antidioxants from the raw materials it is made from and soluble fiber, all of which contribute to a healthy diet, all essential for the nervous system.

It is generally believed that large intake of palm wine or beer has the ability to cause the consumer tipsy and loose gait; a direct influence on the brain – center for co-ordination and movement.Thus, may affect learning and memory. Therefore, the aim of this research was to compare the effect of palm wine and beer on learning and memory using the Morris water maze.

MATERIALS AND METHODS

Acquisition of palm wine and star beer

Fresh palm wine and star beer were bought from Bokobori in Calabar South Local Government Area of Cross River State, Nigeria. They were stored in a cool dry place until required for constituting the palm wine and beer-treated groups.

Animal treatment

25 Swiss white mice weighing between (15-30 g), were kept in well ventilated space under room temperature (25 ± 2^0C) and 12/12 hours light/dark cycle, and allowed one week for acclimatization to the research environment before testing mice were housed singly in metabolic cages. Each mouse in each of the groups received 1 ml and 2 ml of palm wine (palm wine group), 1 ml and 2 ml of beer (beer group). Each mouse was given normal rodent feed and drinking water ad-libitum. This treatment was done for 28 days. Their beddings, feed and water were hygienically handled and changed every 1-3pm daily throughout the period of this treatment.

Morris Water Maze set-up

The Morris water maze developed by Richard Morris (Morris R, 1984) for assessing visuo-spatial learning and memory was used in the study. The water maze made of a circular polypropylene pool that measured 85 cm diameter and 20 cm in depth was used. The pool was filled to depth of 14 cm with room-temperature tap water. The water made opaque with the addition of milk to ensure camouflage of the white escape platform. The platform was submerged to about 1 cm below the water surface.

The pool was then divided into 4 quadrants: Northwest (NW), Northeast (NE), Southwest (SW) and Southeast (SE). Boundaries of this quadrant were marked on the edge of the point with masking tape and labeled, North, South, East and West. The level of water in the pool was adjusted to 1 cm above the platform thus creating an invisible platform.

The pool was located in the laboratory room. On the walls of the room were mounted several posters to act as visual cues. They were also furniture and electronic (TV Set) that provided visual cues. During testing, the room was dimly lit with diffuse white light. The performance of the animals in the maze was recorded both manually and electronically, using a camcorder and behavior rescored manually afterwards.

Testing in the Morris water maze lasted eight days. The first three days were acquisition training with an invisible platform. The next three days were reversal training with the hidden platform in an opposite quadrant. On the seventh day a probe trial was conducted with no escape platform. On day eight, 4 trials were conducted with a visible platform.

During the test period, the mouse was placed in a clean empty cage (with paper towel bedding to allow the mice to dry more quickly) after each trial. Mice were then run in squads of 7 with 10 minutes between each trial for each mouse.

During acquisition and reversal training, as well as the visible platform task, mice were given 4 trials of 60 seconds each to locate the hidden platform (or visible platform in the visible platform task). After this, if they did not locate the platform, they were guided to the position of the platform within the 60 seconds, the timer was stopped and the time it took the mice to locate the platform was recorded as the swim latency.

A probe trial was conducted on day seven. At this time, there was no escape platform in the maze. Each mouse completed one trial of 60 seconds. Each mouse was placed in the maze from one of the four possible positions and allowed to explore the pool. The durations in each quadrant and the frequency of entry into the acquisition and reversal quadrants were recorded.

Statistical Analysis

Data collected during the study were expressed as mean ± SEM. Analysis of variance (ANOVA) and a post-hoc data student t-test were used for analysis of data. Probability level $p<0.05$ was regarded as significant.

RESULTS

Swim Latencies during Acquisition and Reversal Training in the Morris Water Maze

The swim latencies (time to find and mount the escape platform) of the palm wine-treated mice for the three days of acquisition training was significantly lower ($p<0.05$) compared to control. Swim latencies of the beer-treated mice was significantly lower ($p<0.05$) compared to both palm wine and control groups of mice (Fig. 1). During reversal training, the swim latencies of the beer-treated mice was similarly lower ($p<0.05$) compared to control. However, there was no significant difference between the palm wine and beer-treated groups (Fig.2).

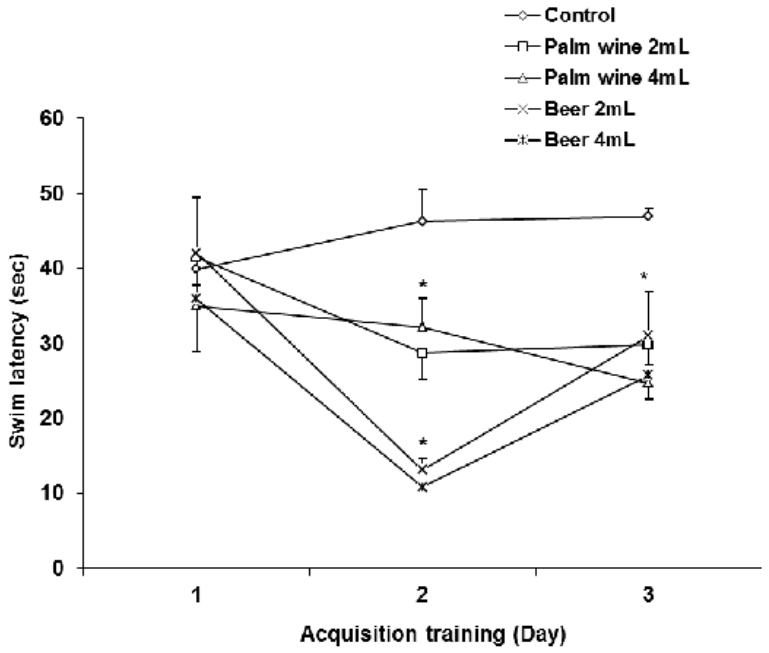

Figure1: Comparison of swim latency during acquisition training on days 1, 2 and 3 of the Morris water maze in the control and test group. Values are expressed as mean ± SEM. *p<0.05 vs control.

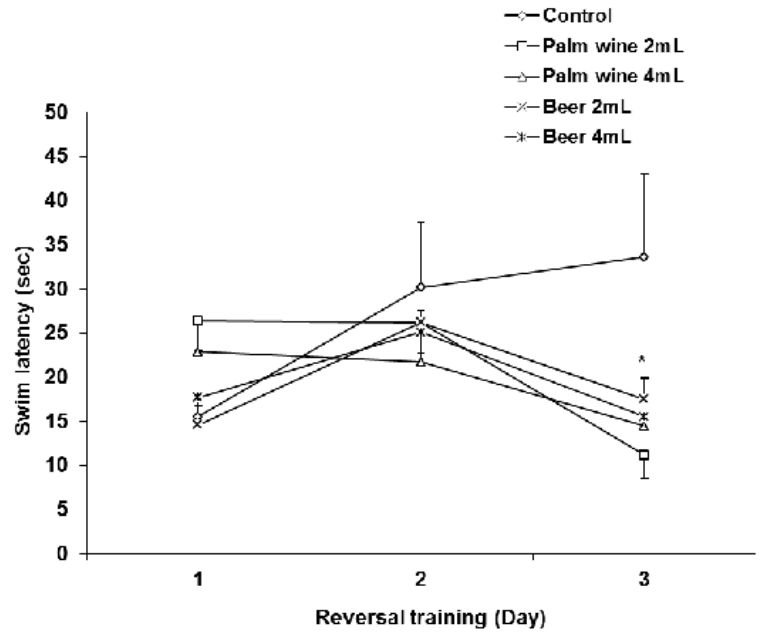

Figure 2: Comparison of swim latency during reversal training on days 4, 5 and 6 of the Morris water maze in the control and test group. Values are expressed as mean ± SEM. *p<0.05 vs control.

Quadrant Duration during the Probe Trial in the Morris Water Maze

Fig. 3 compares the quadrant duration during the probe trial in the Morris water maze between the three experimental groups of mice. During the probe trial, the NW quadrant (time in the quadrant with hidden platform during acquisition training) was significantly higher ($p<0.05$) between the palm wine and beer-treated groups as compared to control; it tended to be higher in the beer-treated group when compared to the palm wine group. The time spent swimming in the NE quadrant was significantly lower ($p<0.05$) between the palm wine and beer-treated groups as compared to control. In the SW quadrant, the time spent in swimming in the beer-treated group of mice was significantly higher ($p<0.05$) when compared to palm wine group, even though not statistically different from the control group. In the SE quadrant (the quadrant with hidden platform during the reversal training - also called retention quadrant), the time spent swimming was significantly higher ($p<0.05$) in the palm wine treated group as compared to control. The beer-treated group however, was significantly lower ($p<0.05$) as compared to palm wine and control groups.

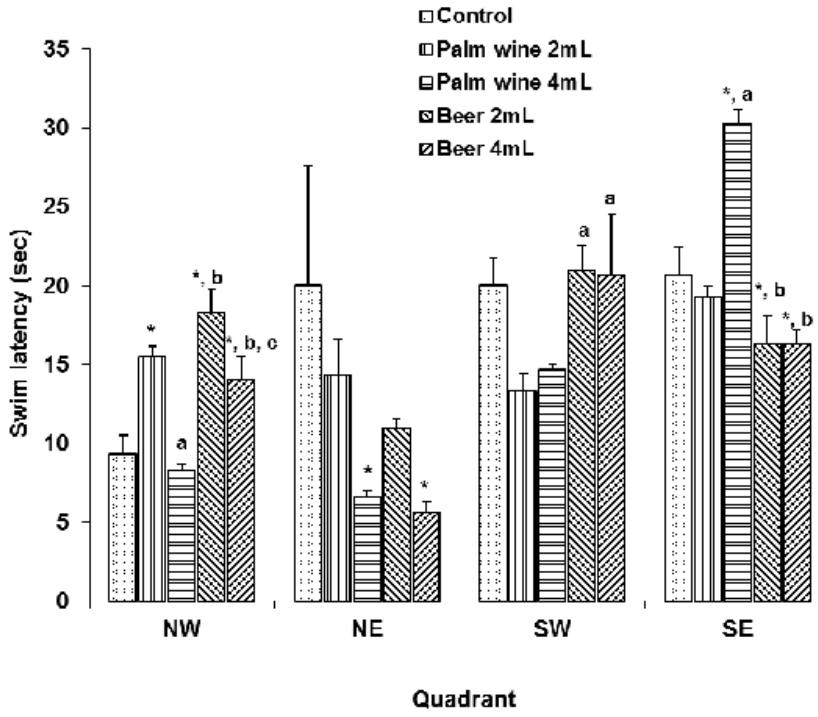

Figure 3: Comparison of swim latency during probe trial on day 7 of the Morris water maze in the different groups. Values are expressed as mean ± SEM.
***p<0.05 vs control;**
a = p<0.05 vs palm wine 1mL;
b = p<0.05 vs palm wine 2mL;
c = p<0.05 vs beer 1mL.

Annulus Crossing during the Probe Trial in the Morris Water Maze

Fig. 4 compares annulus crossing during the probe trial on day 7 in the Morris water maze between the experimental groups of mice. During the probe trial, the annulus reversal crossing (number of times the mouse crosses the location of the platform during reversal training) was significantly lower ($p<0.05$) in the beer-treated mice than in the palm wine group. Whereas, annulus reversal crossing was significantly higher ($p<0.05$) in the palm wine group than control and beer treated groups. Conversely, annulus acquisition crossing (number of times the mouse crosses the location of the platform during acquisition training) was significantly higher ($p<0.05$) in beer treated mice than palm wine treated mice. However, there was a significant decrease ($p<0.05$) in annulus acquisition crossing between palm wine and beer treated groups of mice as compared to control.

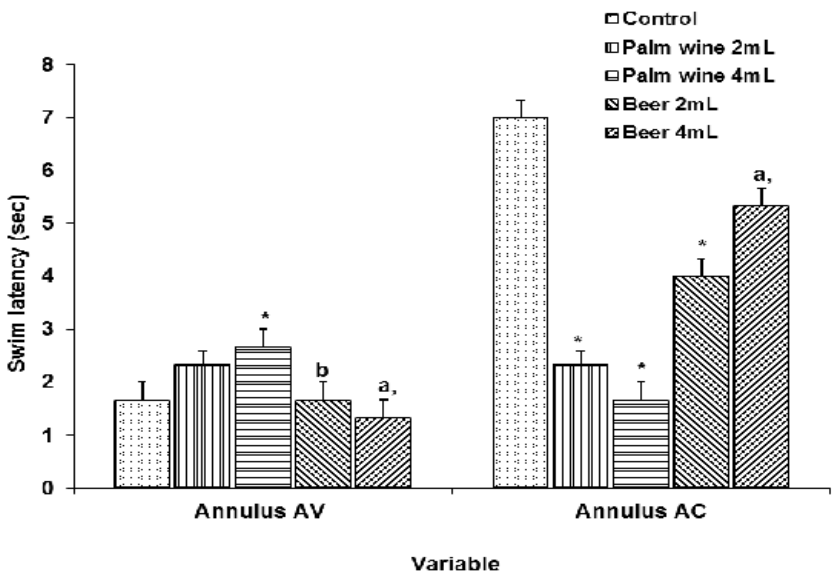

Figure 4: Comparison of annulus AV and AC during probe trial on day 7 of the Morris water maze in the control and test group. Values are expressed as mean ± SEM.
***p<0.05 vs control;**
a = p<0.05 vs palm wine 1mL;
b = p<0.05 vs palm wine 2mL.

Swim Latencies during the Visible Platform Task in the Morris Water Maze

Fig. 5 compares the swim latencies between the mice fed palm wine, beer and control group. During visible platform task, the swim latency of the palm wine treated mice was significantly lower ($p<0.05$) than beer treated mice and control group. However, swim latency of beer-treated mice was significantly higher ($p<0.05$) than palm wine treated and control groups.

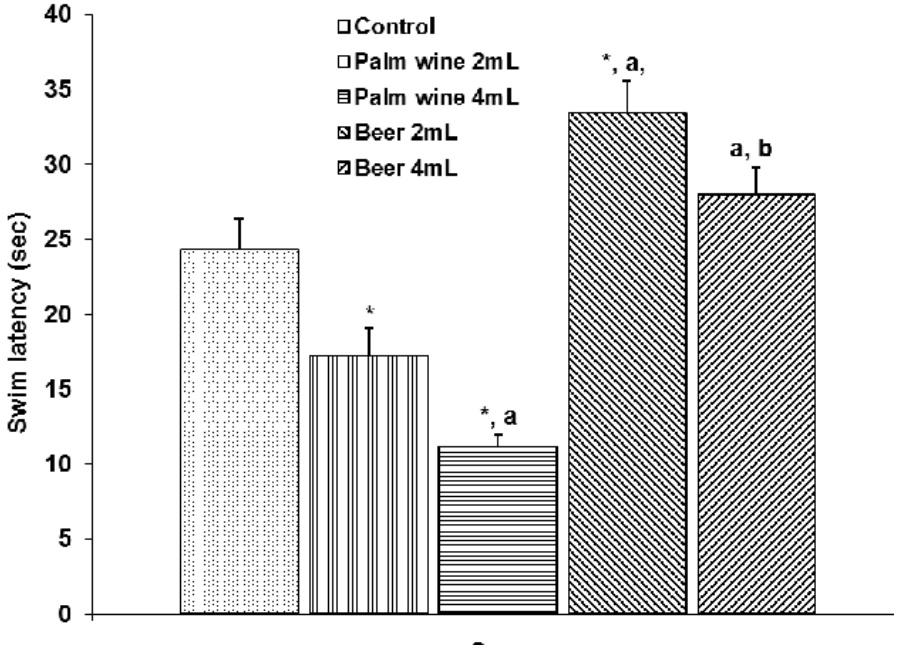

Figure 5: Comparison of swim latency during visible platform on day 8 of the Morris water maze in the control and test group. Values are expressed as mean ± SEM.
***p<0.05 vs control;**
a = p<0.05 vs palm wine 1mL;
b = p<0.05 vs palm wine 2mL.

DISCUSSION

The hidden platform version of the Morris water maze tests for visuo-spatial learning and memory is hippocampus dependent (McDonald RJ, White NM, 1994). Stimulation or inhibition of hippocampal neurons would affect learning and memory. Conversely, the visible platform version of the Morris water maze is a non-hippocampal task, which is dependent on the caudate nucleus and putamen of the basal ganglia. The visible platform uses a unique intra-maze visual cue that is placed at the location of the escape platform whereas the visuo-spatial learning task uses extra-maze cues (McDonald RJ, White NM, 1994). The brain is unique in its ability to add to its stock of information by acquiring information (learning), retaining and retrieving the information (memory) as appropriate (Ganong WF, 2005).

Mice which learn faster would locate the hidden platform earlier than their counterparts (i.e. shorter swim latencies). The results from this study showed that during the 3-day acquisition and 3-day reversal training, the swim latencies were shorter in the palm wine treated mice compared to beer treated and control groups. This observation suggests better learning and memory in the palm wine group. The swim latencies during the visible platform task as observed indicates that the palm wine treated mice had a shorter time to locate the platform as compared to beer-treated and control groups. This implies that the yeast content in the palm wine may have sharpen their acuity and also stimulate the caudate nucleus and putamen of the basal ganglia to increase locomotor activity (Umoren EB, et al, 2015). However, as shown in the result the beer-treated mice had longer swimming time to locate the platform when compared to palm wine treated and control groups. This is not however due to any visual impairment but the ability of the beer to suppress locomotor activity when taken in large doses.

During the probe trial of the Morris water maze test (the reversal quadrant is the retention quadrant) it is expected that mice which have learnt the position of the hidden platform during the reversal training would spend more time exploring the reversal (retention) quadrant in search of the hidden platform. The mice in the beer treated group showed greater preference for NW quadrant (platform location during acquisition training). This was not significantly different from those in the palm wine treated group but higher as compared to control group. In the NE quadrant (the visible platform task) the control group stayed longer in this platform as compared to the other two groups. This was closely followed by the palm wine group. This implies that the palm wine treated group having a better learning and memory retention as showed in the results spent longer time in this quadrant as compared to beer group. The beer treated group stayed longer in the SW quadrant as compared to the palm wine and control groups. Palm wine treated group spent more time in the SE quadrant (platform location during reversal training) compared to beer treated and control group. This implies that the palm wine group had better visuo-spatial memory.

The overall performance in the Morris water showed that the palm wine treated group had better performance during the acquisition and reversal training which shows better learning ability and memory retention. This was however not statistically different from the beer treated group. Similar trend was observed in probe/retention trial test. It is possible that the bioactive compounds (Okwu DE, 2005) present in palm wine had a more stimulating effect on the nervous system hence better performance in learning and memory as compared to beer treated mice.

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ISSN : 0976-4550

INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

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Website: www.ijabpt.com