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The effect of 30 days for nutritional support of cooked beef liver rich in choline, zinc, and vitamin B_{12} on the reaction time development of male students

El-Amira Noura A. Awad*, Walaa. M. Aniess, Zenab M. Mosaa and Nadia E. El-Housseiny
Home Economics Department, Faculty of Specific Education, Ain Shams University.
*Corresponding author E-mail: el.amiranour93@gmail.com

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ABSTRACT

Reaction time (RT) is an important method for studying the centralized data processing speed of individuals and the coordinated and rapid response to their movement. Accordingly, RT is essential for officers, soldiers, doctors, drivers, pilots, security guards, etc. to succeed in their fields. Previous studies have mainly focused on RT with regard to the psychological and neurological domain, and there have been very few studies on reaction time and nutritional support beside quality of food or drink consumed. The current study aimed to improve the reaction time of healthy college students after providing them with natural nutritional support highly rich with choline, zinc, and vitamin B_{12} represented in the food source “municipal liver” by 250 grams after cooking. The study sample consisted of 14 students from the Faculty of Agricultural and Environmental Sciences at Suez Canal University. The students were divided into two groups, the control group of 5 students and the experimental group of 9 students. A blood sample was taken from all students before starting the experiment to measure the proportion of choline, zinc, and vitamin B_{12} in their blood plasma, and the reaction time was recorded before using five measures of computer reaction time on the Internet according to Jim Allen (2002). Daily nutritional support was given to the students of group (2) using the natural food source, the municipal liver, for 30 days. After 30 days, a post-laboratory blood sample was drawn to measure the proportion of choline, zinc, and vitamin B_{12} in the investigated students' blood plasma of both groups. Also, the post-reaction time was recorded for them. The findings revealed that there was a significant improvement in RT for students of a group (2) who took natural supplements compared to the control group. The results also indicated that their research sample performed better in laboratory analyses ($P < 0.01$) and response time schedules Online action ($P < 0.01$). According to the findings of the research, choline, zinc, and vitamin B_{12} as natural food sources have a positive effect on the improvement of reaction time.

Keywords**:** Reaction time, Choline, Zinc, Vitamin B_{12}.

INTRODUCTION

Food affects the neurochemistry of the brain and the development and integration of the nervous system, so it plays an important role in the development of intelligence, cognitive development, and memory activation, and influences the learning behavior of students and their achievements through some fundamentals. According to several pieces of research, a lack of some necessary nutrients such as iron, zinc, certain vitamins, and essential fatty acids has a detrimental influence on the development of pupils' cognition, comprehension, and accomplishment (Aiman *et al*,. 2014).

Choline is an important component that must be received through food because its production is insufficient to fulfill human requirements. Choline is essential for lipid transport, cell membrane structural support, and neurotransmission via acetylcholine (Mun *et al,*.2019). Acetylcholine, a neurotransmitter of the nervous system, is an essential neurotransmitter that affects processes such as memory, attention, sleep, heart rate, and muscular activity (S.F.N. 2012). Acetylcholine is required for biliary neuron activity in order to transmit nerve impulses. It is utilized as a dietary supplement in the treatment of a variety of ailments, including liver problems and mental and neurological disorders (Biswas and Giri, 2015; Antonio and Gustavo, 2017).

Zinc is essential for development, neuronal function, the immune system, and reproduction. It influences nerve impulse transmission. Its insufficiency may induce ADHD (attention deficit hyperactivity disorder) by delaying cognitive development (Arnold *et al.,* 2000; Steve 2008). Changes in attention, activity, neuropsychological behavior and motor development may all be affected by zinc deficiency. Zinc is required for neurogenesis, neuronal migration, and synapse formation, and a lack of it can disrupt neurotransmission and consequent neuropsychological behavior. Zinc deficiency during a period of fast brain growth, such as adolescence, impacts cognitive development by lowering activity, increasing emotional behavior, and affecting memory and learning capacity in both animals and humans (Shinjini and Sunita, 2001).

Vitamin B_{12} (cyanocobalamin) is an essential human nutrient (Lindsay *et al.,* 2018). In the neurological system, neurotropic B vitamins play an important function as coenzymes and beyond. Vitamins B_1 (thiamine), B_6 (pyridoxine), and B_{12} (cobalamin) is especially important for maintaining a healthy neurological system. Many neurological disorders are linked to deficits in one or more of these vitamins, although they can help with some neurological conditions even if there isn't a (confirmed) deficiency (Calderón-Ospina and Nava-Mesa 2020). The nervous system needs vitamin B_{12} because its deficiency affects cognition and therefore reaction time (Zayed, 1994).

The interval of time between the presentation of a stimulus and the manifestation of an acceptable voluntary response in a subject is described as reaction time (RT), and it is commonly stated in milliseconds. Reaction time is critical in our daily lives and requires healthy sensory systems, cognitive processing, and motor function. RT is an excellent predictor of an individual's sensorimotor coordination and performance. A person's awareness is determined by their reaction time (Wadoo and Syeed, 2019). RT of an organism is a measure of how quickly it responds to a type of stimuli (Jain *et al.,* 2015). To elicit a response from the neurological system that identifies the stimulus, neurons send the message to the brain, which then sends the message to the spinal cord, which then sends the message to the person's hands and fingers. The motor neurons then instruct the hands and fingers on how to respond. Because of the practical ramifications, RT in reaction to a scenario might have a significant impact on our life. Fast RTs can provide outstanding results (in sports and medicine), but sluggish RTs might produce terrible effects (driving and road safety problems). Age, gender, left or right hand, central vs peripheral vision, exercise, weariness, fasting, breathing cycle, food, and sleep are all factors that can impact normal human recovery (Gokhale *et al.,* 2012).

In psychology, reaction time is referred to as latent time, which is the time between the presentation of a stimulus and the organism's response to it, or the time necessary to activate a preprogrammed response to a certain stimulus. Whereas response time relates to the speed with which decisions are made and tasks are completed. Furthermore, the notion of RT may be used to indicate a person's cognitive processing speed in the human nerve system (Khodadadi *et al.,* 2014).

Simple and complicated response times are the two forms of RT. The period when an individual merely reacts to single stimuli, such as when people have to click a button to hear a sound or view a visual stimulus, is referred to as simple response times. There are numerous varieties of complex reaction time, which are as follows: To begin, the selective reaction time refers to the period during which the subject must have distinct responses to different stimuli, such as pressing different buttons in response to different stimuli. The second is recognition response time, in which individuals are instructed to click a button not just when there is a stimulus, but also when there is none. The third type of discrimination is based on reaction time. At this reaction time appointment, respondents are asked to pick one of two stimuli that match preset characteristics. For example, amid two or more colored visual stimuli, a blue stimulus must be chosen and shown by pushing a button (Kosinski, 2010; Miller and Low, 2001).

Neurotransmitters, which are chemical substances created in the central nervous system as a result of the breakdown of dietary molecules, carry information from the brain (Wnuk *et al.*,2018). The mind is the fundamental organ of the nervous system, where it monitors and organizes responses, sensory processes, and the majority of organ operations, as well as mental tasks such as learning and remembering (S.F.N, 2012).

This work aimed to improve the reaction time by adding some complementary foods including choline, vitamin B_{12} and Zinc.

MATERIALS AND METHODS

1. Materials:

Twenty-six students from the Faculty of Agricultural and Environmental Sciences- at Suez Canal University were invited to participate in the experiment. But the experimental participants were selected as per the following criteria:1) Be in the same grade at the college, 2) similar in academic achievement, 3) same-sex male, 4) healthy and doesn't have an obvious or chronic physical illness, with no cardiac, hepatic, renal, neurological, or psychiatric disorders, or has a food allergy, personal history of depression, migraine, and drug use, 5) follows a normal diet, with vegetation and meat, 6) does not drink coffee or any caffeinated drink, 7) non-smoker.

According to the previous criteria and the consent of the individuals to participate in the experiment; 14 participants were selected. Their average age was 19± 4.7 years, height 175±7.1cm and weight 78.1±6.4 kg.

All participants in (the experimental group) were given 250g of cooked beef liver daily for 30 days to investigate the effects of this supportive nutrition with its food ingredients on their reaction time. Furthermore, all the personal data, socioeconomic status, dietary habits, and nutritional history, had been taken for each student. Also, each one gave approval or informed consent to participate in the experience. All participants were free to withdraw from the study at any time. The liver was purchased from the local market, and analytical tubes and syringes for blood sampling were purchased from a pharmacy.

2. Methods:

2.1 Study design

The current investigation extends to 30 days period. It is designed to compare the effect of taking cooked beef liver, as a source of V. B_{12}, choline, and zinc versus a normal diet, on the reaction time in the investigated healthy students. Twelve participants were divided randomly into two groups;

1-Control group (n-5): No dietary intervention was performed for this group as this group consumed their usual diet.
2-Experimental group (n=9): This group was provided a cooked beef liver at approximately 250g/day/person for 30 days as a source of vitamin B_{12}, choline, and zinc.
The concentration of vitamin B_{12}, choline, and zinc in the blood of students of two groups were measured before and after the first experiment.

Meanwhile, the five tests of reaction time were used in this study. One-Choice Visual Reaction Time (Choice RT) tasks and Four-Simple Visual Reaction Time (Simple RT) tasks.
All groups were subjected to the following:
1. A form was filled out that included personal data and socioeconomic status.
In addition to any questions related to whether or not he smokes, takes nutritional supplements or his doctor's drugs, suffers from any chronic health problem, or uses video games or not.

2.2. Anthropometric evaluations
The Quetelet index connects weight (kg) to height (m^2), allowing body mass index to be calculated (BMI) after Dwyer (2006) as follows:
BMI= $\boldsymbol{Weight\ (kg)\ \div height}$ (m^2)
BMI predicts illness risk in persons classified as underweight and obese. The World Health Organization defines underweight as having a BMI of 18.5, normal as having a BMI of 18.5 to 24.9, overweight as having a BMI of 25 to 29.9, obese as having a BMI of 30 to 39.9, and severe obesity as having a BMI of 30 to 40 (WHO, 2005).

2.3. Nutritional Intake Evaluation:

A seven-day 24-hour dietary recall was used. Quantities of various food and drink kinds were recorded by students who were instructed to record the quantities taken. These data were examined for macro and micro components using the National Nutrition Institute's food composition tables and compared to nutrients with Recommended Dietary Allowances RDA (WHO, 2005) and Reference Nutrient Intake RNI (USDA, 2011).

- Food habits:

The nutritional questionnaire was designed by the researchers and the required information was taken from the students themselves through a questionnaire that includes: breakfast, lunch, dinner, meals between the main meals, and the type and quantity of food.

- Diet history:

Dietary history includes a list of food groups. The detailed dietary questionnaire was conducted in conformity with the standard questionnaire sheets of the National Nutrition Institute in Cairo. It includes data on general dietary items with regard to quality and frequency of consumption. Mothers of students were asked about all various food types intake by their children eaten per day or week or month or year (Jelliffe, 1966).

2.4 Nutrition sources preparation for experimental study
Preparation of beef liver

The fresh beef liver was purchased daily from the local market (about 250 grams per person) for 30 days. Beef livers were cut into thin strips, soaked in milk, and then seasoned with sea salt. Also, add white vinegar, and simmer for another 1-2 minutes. Put vegetable oil in a large frying pan over high heat, add a small amount of garlic and green pepper to it and cook for 1-2 minutes (Habib, 2010). The heat was lowered to its medium then adds some mashed garlic and continue to cook the liver for 10 minutes. Squeeze some lemon juice on the liver. The Cooked beef liver was served with (Baladi- Local bread) and sweet pepper or without.

2.5- Biochemical analysis:

Venous blood samples were collected from participants by the commercial lab (El asema lab, Ismailia, Egypt) and processed as per the World Health Organization (WHO) blood collection guidelines (WHO, 2010). Samples were collected after obtaining participants' permission. Venous blood was drawn from the subjects in the morning, without regard to fasting or no fasting state before starting the experiment study and immediately after the experiment ended. A blood sample was drawn from each participant evacuated into blue-capped trace metal-free vacationers containing sodium citrate as an anticoagulant (Becton Dickinson, Oxford). All blood samples were labeled with the participant's unique code and then taken to measure for vitamin B_{12} (pg/ml) using a spectrophotometry method (Li and Chen 2000), choline (U/l) according to Woollard and Indyk (2000) method, and Zinc (ug/dl) according to the method of Belay *et al*. (2021).

2.6 Biomechanical analysis:

Reaction time (RT) was used in this study to measure how fast an individual can execute study-related mental operations through the relationship between the strength of his visual attention, as well as motor response and movement time towards the stimulus. Therefore, five measures of reaction time were used in this study. One-Choice Visual Reaction Time (Choice RT) tasks, and Four-Simple Visual Reaction Time (Simple RT) tasks, were presented on portable computers (Windows 10 Systems with a 15.60-inch display, Intel® Core™ i5-4210U, Hewlett-Packard (HP), USA). All tests measured reaction time in milliseconds and all were practiced prior to the Day 0 baseline measure. These tests have previously been shown to be among the most sensitive to the effects of nutritional variables on human performance (Kosinski, 2008; Baisch *et al.*, 2017).

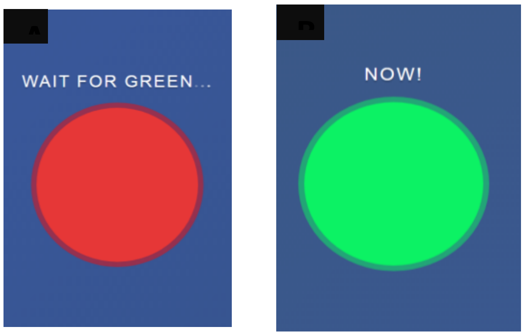
2.7 Reaction Time (RT)

a- Simple Visual Reaction Time (Simple RT)

Four measures of the Simple RT task (Test-1, Test-2, Test-3, and Test-4) were used in this study with five tries each and the average reaction time was calculated. In Test-1, known as to go/no-go RT tasks, participants sat infront of a computer screen holding a mouse in their dominant hand. When a yellow light appears on the screen, participants press rapidly a left switch of a mouse with the thumb of their dominant hand and do not respond when a red light appears (Fig. 1). Also, Test-2 was conducted in the same manner as Test 1 except participants pressed rapidly the button when a green light appears and not respond when a red light appears (Fig. 2). As well as, Test-3, known as a Red-Green traffic light (Allen, 2002), participants click the large button on the right to begin and wait for the stoplight in the traffic light to turn green. When the stoplight turns green, participant click the large button quickly by mouse (Fig. 3). While Test-4, known as the Hit-the-Dot task, based on Fitts' Law, it tests reflexes and hand-eye coordination (DeVocht *et al.,* 2019). This test consisted of a series of 30 circles. Each time one circle appears on the screen. Participants, using the mouse, click the cursor into the appeared circle as quickly and accurately and move the cursor from the circle to the other circle that will appear later. Circles were identical in size, but it is never known in advance where to position the circles will appear (Fig.4).

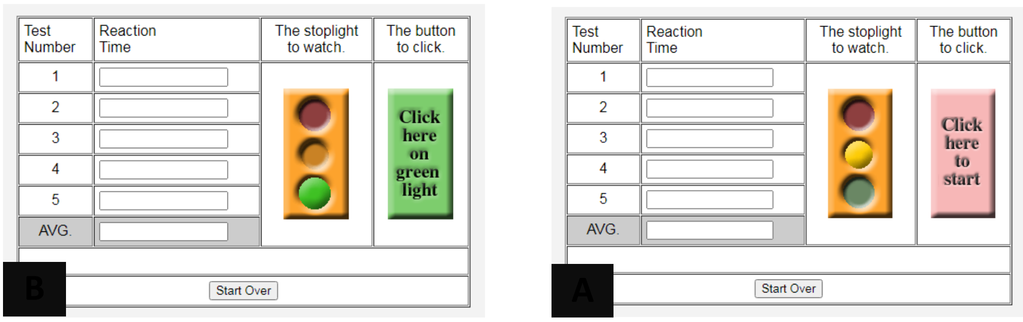
(A) **(B)**

Fig.1. Depiction of computer image used for the go/no-go RT task (Test 1), A) refers to the test start screen and B) the yellow color represents the motivation for the participants to quickly press the left mouse key within the yellow circle.



(A) **(B)**

Fig.2. Depiction of computer image used for thego/no-go RT task (Test 2), A) refers to the test start screen and B) the green color represents the motivation for the participants to quickly press the left mouse keywithin the green circle.



(A) **(B)**

Fig.3. Depiction of computer image used for thea Red-Green traffic light task (Test 3), A) refers to the test start screen and B) the green color represents the motivation for the participants to quickly press the left mouse key within the green box.

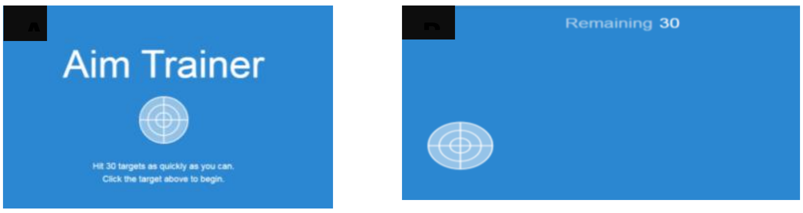
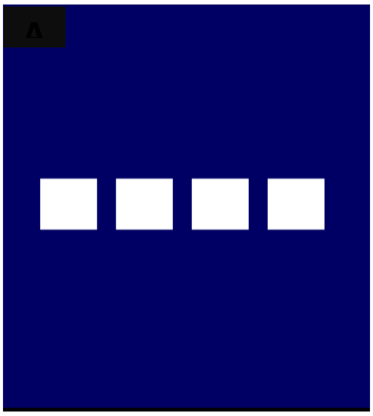


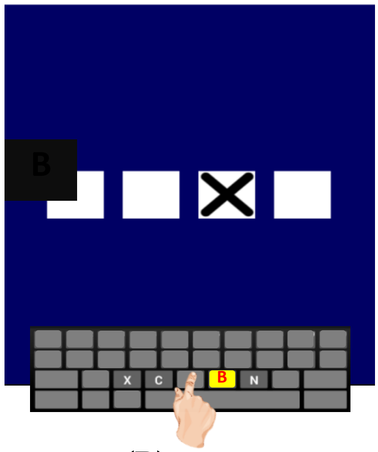
Fig. 4. Depiction of computer image used for a Hit-the-Dot task (Test 4), A) refers to the test start screen and B) shows the circle that the participant clicks on and then moves the cursor using the computer mouse from one circle to another

b. Choice Visual Reaction Time (Choice RT)

It includes one task (Test 5), known as the Deary-Liewald paradigm (Nissan 2011). There have multiple stimuli, and each stimulus requires a different response. Participants see one of the four letters (X or C or B or N) which counts as four different stimuli that appear randomly in one of four locations at white boxes on the computer screen. Each time participants see one of these letters, they need to press rapidly the corresponding letter key on the keyboard (Fig. 5). This task will repeat itself multiple times. Participants applied this task five tries and the average reaction time was calculated.



(A)



(B)

Fig.5. Depiction of computer image used for the Deary-Liewald paradigm test (Test 5), A) refers to the test start screen and B) refers to a participant pressing a key on the keyboard (one of the four letters X or C or B or N) corresponding to the X location that appeared on the white box.

2.8. Statistical analysis:

All analyses were performed with SPSS version 22.0 (IBM Corp. 2017) for Windows (Chicago, IL, USA), and ($P<0.05$) was considered statistically significant. Data were expressed as the mean ± standard deviation (SD). Two groups were compared with a non-parametric the Mann Whitney u test for independent groups, paired samples and the wilcoson runk sum test. In addition, one-way ANOVA was applied to compare changes in reaction times between treatment groups. Then Mean values of treatments were differentiated by using the least significant range (Duncan's multiple range tests) at 0.05% level probability (Duncan, 1955).

RESULTS AND DISCUSSION

Beef liver is one of the richest sources of choline, containing over 414 milligrams per 100 grams, which is about the daily amount required (Dan Brennan, 2020), also it is the source of zinc, containing over 11.20 milligrams per 100 grams, which fulfills 45 percent of the RDI (Kerns, 2018; Lawler and Klevay, 1984) and a 100-gm serving of beef liver contains about 5.9 mcg of vitamin B_{12} that's 245% of the daily value (DV) (3,460% of the RDI) (Arlene-Semeco 2022).

It is clear from Tables (1 & 2), and Figure (1) that there were no statistically significant differences between the experimental group, and the control group and they are equal in both the experimental group and the control group with respect to the measured proportion of vitamin B_{12}, choline, and zinc in the blood plasma (pre-nutritional support). A negative result for those elements mentioned previously, as the differences between the two groups appear before, and after nutritional support for vitamin B_{12}, choline, and zinc by analyzing the proportions of these elements in the blood plasma. There was an improvement in the laboratory indicators resulting from the dietary intervention (liver) for both choline, vitamin B_{12}, and Zinc, (67.96±8.33, 278.11±27.90, and 221.00±28.14, respectively at (P<0.01). This is consistent with the study of Gille and Schmid (2015) who reported that the highest source of (Cbl) is the liver. The results after taking the supplement showed that there was a rise in the levels of vitamin B12 and folic acid in the plasma (Yusr *et al.*, 2009). These results go in line with those reported by Önel *et al.,* (2017), Zeisel (1994), and Zeisel *et al.,* (1991) who found that the concentration of choline in plasma and body was decreased below normal levels in individuals who did not follow a diet rich with choline and vice versa. Meanwhile, Coppen and Davies (1987) found that when zinc was increased in dietary the amount of zinc absorbed increased linearly at higher dietary levels.

Guo and Wang (2013), and Hess *et al*, (2007) found that patients who received Zn supplements in food for eight weeks had higher plasma concentrations of Zn than the control group. Also, beef liver is rich in iron, which has been shown to enhance zinc absorption but within certain limits and vice versa and Iron deficiency do not increase zinc absorption (Solomons, 2001). On the same line, the rate of zinc absorption is high when eating cooked beef due to the presence of some influential factors that protect zinc from absorption inhibitors (Castillo-Duran and Solomons, 1991).

Generally, results are quite evident that the inclusion of beef liver in the participants' diet enhances the proportion of choline, vitamin B12, and zinc in the body.

Table (1). Levels of vitamin B_{12}, choline, and zinc in blood of the control and experimental groups Pre-and post-nutritional support of the beef liver for 30 days.

Test	Pre-treatment Mean±SD		Z	Sig.	Post-treatment Mean±SD		Z	Sig.
	Control group (n=5)	Experimental group (n=9)			Control group (n=5)	Experimental group (n=9)		
$V.B_{12pg/ml}$	188.00±37.64	186.77±26.46	-0.092	1.000 (ns)	197.33±17.00	278.11±27.90	-2.496	0.009 (ns)
$Choline_{u/l}$	54.36±6.95	56.34±6.51	-0.649	0.600 (ns)	55.20±4.95	67.96±8.33	-2.126	0.036 (ns)
$Zinc_{ug/dl}$	91.00±8.54	103.33±15.33	-1.204	0.282 (ns)	102.00±9.16	221.00±28.14	-2.311	0.018 (ns)

With regard to the nutritional effect of choline, vitamin B_{12} and zinc on improving the reaction time of the participants, Tables (3 & 4) and Figure (2) showed that there were no statistically significant differences before and after the experiment for the levels of performance in the 5 tests to measure the reaction time of the participants in the control group as shown in the analysis of tests measurements , but there were significant differences at (P<0.01) between the pre- and post-food support for the experimental group, as evidenced by the analysis of the measurements of 5 tests of the reaction time of the participants in a mean ±SD (Test-1) 0.479±0.040; (Test-2) 0.472±0.042; (Test-3) 0.521±0.038; (Test-4)

0.474±0.046; (Test-5) 0.478±0.025 for the reaction time tests compared to the control group. These results are in consistent with that of Catherine and Lorenza (2017) who found positive effects of choline supplementation on cognitive enhancement. In healthy humans, choline is a promising tool for enhancing memory and cognitive function in individuals, a long-term choline-rich diet enhances cognitive performance throughout life, and short-term choline supplementation has the potential to enhance various cognitive processes, especially in those with poor performance. A study of Rashid (2017) showed that nutritional supplementation with choline led to a significant improvement in measures of attention, cognition, and memory, and since they are a series of important perceptual processes, choline has a positive effect in improving the indicators and measures of reaction time tests, considering that cognition, attention, and memory effect on reaction time. The results were consistent with the study of Shinjini and Sunita (2001) which showed that zinc deficiency during the period of rapid brain development, or the juvenile and adolescent period affects cognitive development by decreasing activity and increasing and impairing emotional behavior.

Zinc is important in the regulation of neuronal glutamate transmission, implying a probable relationship between zinc and memory functions. Supplementing with zinc improved cognitive performance across all tasks. These findings indicated that zinc can be used as a viable treatment strategy for cognitive impairment (Leslie *et al*., 2017) and dietary zinc deficiency may impair learning and memory (Bhatnagar and Taneja 2001; Zheng *et al*., 2011). There is some evidence of improved neuropsychiatric function and the long-term effects of zinc's effect on cognitive development. As a neuromodulator, zinc helps to regulate neuronal excitation (Koyama *et al.,* 2014). There is some evidence that zinc supplementation improves cognitive functioning (Shinjini and Sunita, 2007). In parallel, zinc plays a very important role in defines against
oxidative stress associated with mental decline and in improving cognition. Adequate nutrition is essential to improve brain function and prevent cognitive decline. The current results are also consistent with the study of Rosa *et al*., (2018) who showed that vitamin B12 and choline affect nerves and improve intellectual performance directly. The deficiency of vitamin B_{12} is related to cognitive skills, namely the nerves, and because its deficiency prevents the production of myelin, the decline in the ability to produce it leads to disruption of the work of the nervous system, which is manifested in the disease of the surrounding nerves that are at the outer ends of the body such as the toes or the bottom of the feet or the tips of the fingers of the hands because vitamin B12 is an important element for the safety of the nervous system, the severe deficiency in it leads to damage to the nerves that cannot be repaired, and it is very painful and incurable. Meanwhile, Zayed (1994) mentioned that the deficiency of this vitamin affects perception and memory and therefore reaction time.

Table (3): The reaction time (R.T.) of control and the experimental groups Pre-and post-nutritional support of the beef liver for 30 days.

	Pre-treatment Mean±SD		Z	Sig.	Post-treatment Mean±SD		Z	Sig.
	Control group (n=5)	Experimental group (n=9)			Control group (n=5)	Experimental group (n=9)		
Test-1	0.910±0.074	0.837±0.037	-1.572	0.116 (ns)	0.977±0.035	0.479±0.040	-2.496	0.013 (**)
Test-2	0.554±0.047	0.522±0.021	-1.202	0.229 (ns)	0.673± 0.032	0.472±0.042	-2.674	0.0010 (**)
Test-3	0.822±0.051	0.822±0.039	-0.277	0.782 (ns)	0.988±0.064	0.521±0.038	-2.496	0.013 (**)
Test-4	1.062±0.051	1.074±0.012	-0.462	0.644 (ns)	1.030±0.015	0.474±0.046	-2.118	0.023 (**)
Test-5	0.650±0.016	0.625±0.034	-1.572	0.116 (ns)	0.730±0.018	0.478±0.025	-1.006	0.034 (**)

• SD: Stander Deviation • ns: non significantly • P <0.01 (**), P <0.05 (*)

Table (4): The effect of nutritional support (the cooked beef liver) for 30 days on the reaction time of the experimental group compared to the control group pre- and post- the nutritional support.

Test	Control group (n=5) Mean ± SD		Sig.	The experimental group (n=9) Mean ± SD		Sig.
	pre	post		pre	post	
Test-1	0.910±0.074	0.977±0.035	1.000 (ns)	0.837±0.037	0.479±0.040	0.006 (**)
Test-2	0.554±0.047	0.673± 0.032	1.000 (ns)	0.522±0.021	0.472±0.042	0.006 (**)
Test-3	0.822±0.051	0.988±0.064	1.000 (ns)	0.822±0.039	0.521±0.038	0.008 (**)
Test-4	1.062±0.051	1.030±0.015	0.102 (ns)	1.074±0.012	0.474±0.046	0.008 (**)
Test-5	0.650±0.016	0.730±0.018	0.593 (ns)	0.625±0.034	0.478±0.025	0.004 (**)

• SD: Stander Deviation • ns: non significantly • P <0.01 (**), P <0.05 (*)

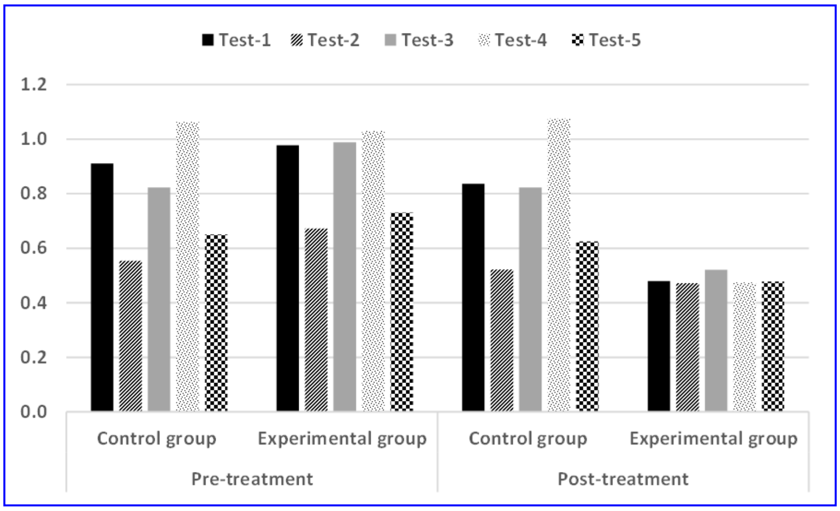


Fig. (2): The effect of nutritional support (the cooked beef liver) for 30 days on the reaction time of the experimental group compared to the control group pre- and post- the nutritional support.

It was obvious from Table (5) and Figure (3) that there were statistically significant differences in RT at P <0.01 between the experimental group (supported with eating cooked beef liver for 30 days) and control group. This finding is consistent with the study of Rosa *et al.*, (2018) who showed that vitamin B_{12} and choline affect nerve function and directly improve intellectual performance. Vitamin B_{12} deficiency is associated with cognitive skills, which are the nerves, and because vitamin B_{12} deficiency prevents the production of myelin, a decrease in the ability to produce it leads to disruption of the functioning of the nervous system, which is manifested in the disease. From the surrounding nerves located in the outer extremities of the body such as the toes, the bottom of the feet, or the tips of the fingers of the hands, because vitamin B_{12} is an important element for the safety of the nervous system, and an acute deficiency in it leads to irreparable nerve damage, which is very painful and incurable. Meanwhile, Zayed (1994) stated that deficiency of this vitamin affects cognition, memory, and thus reaction time.

Table (5): The effect of nutritional support (cooked beef liver) for 30 days on the reaction time of the experimental group compared to the control group post- nutritional support.

Test	Control group (n=5) Mean±SD	Experimental group(n=9) Mean±SD	Z	Sig.
Test-1	0.977±0.035	0.479±0.040	-5.762	0.00 (**)
Test-2	0.673± 0.032	0.472±0.042	-5.745	0.00 (**)
Test-3	0.988±0.064	0.521±0.038	-5.762	0.00 (**)
Test-4	1.030±0.015	0.474±0.046	-5.763	0.00 (**)
Test-5	0.730±0.018	0.478±0.025	-5.5541	0.00 (**)

• SD: Stander Deviation • ns: non significantly • P <0.01 (**), P <0.05 (*)

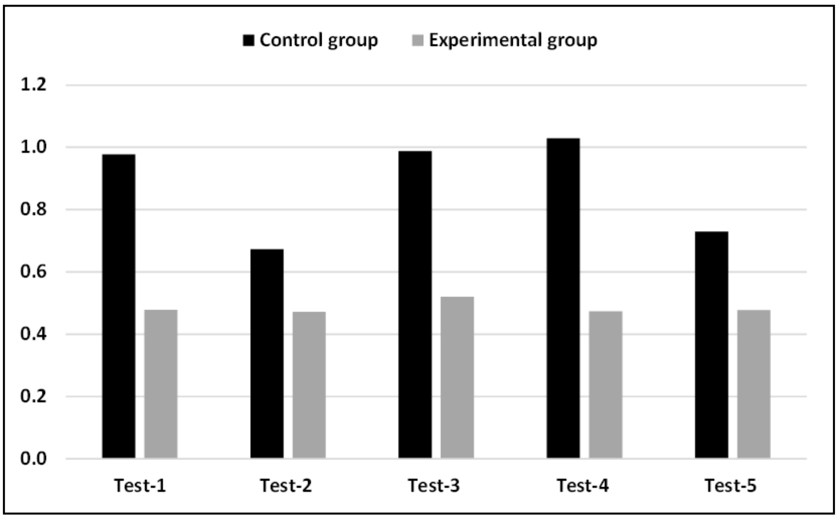


Fig. (3): The effect of nutritional support (cooked beef liver) for 30 days on the reaction time of the experimental group compared to the control group post- nutritional support.

Conclusion and recommendations

The obtained results indicated an improvement in the reaction time as a result of nutritional support with 250 g of daily cooked beef liver due to the presence of choline, zinc and vitamin B_{12} which help increasing their levels in the blood of consumers and positively enhance the reaction time.

The researchers recommend providing students with cooked beef liver to improve their memory, and cognition, and thus reaction time**.** More research has to be carried out including participants of different age groups and on both sexes. Also, further studies on the reaction time according to its types with different nutritional supports have to be carried out.

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تأثير 30 يومًا من الدعم الغذائي لكبد البقر المطبوخ الغني بالكولين والزنك وفيتامين ب $_{12}$ على تطور وقت رد الفعل لدى الطلاب الذكور

الأميرة نورة عوض عوض* ولاء إبراهيم محمد أنيس،زينب مصطفي موسى، نادية السيد الحسيني
قسم الاقتصاد المنزلي بكلية التربية النوعية جامعة عين شمس
***البريد الإلكتروني للمؤلف المراسل: el.amiranour93@gmail.com**

المستخلص

زمن الرجع هو وسيلة مهمه لدراسة سرعة معالجه البيانات المركزية للأفراد والاستجابة المنسقة والسريعة لحركتهم , وبناء علي ذلك, فإن زمن رد الفعل مهم جدا للضباط والجنود والأطباء والسائقين والطيارين وحراس الأمن لتحقيق النجاح في مجالاتهم . ركزت الدراسات السابقة بشكل رئيسي على زمن الرجع فيما يتعلق بالمجال النفسي والعصبي, وكانت هناك دراسات قليلة جدا حول زمن رد الفعل والدعم الغذائي , وجوده الطعام أو المشروبات المستهلكة. هدفت الدراسة الي تحسين زمن رد الفعل لدي طلاب الجامعات الاصحاء بعد تزويدهم بالدعم الغذائي الطبيعي بما يحتويه من ماده الكولين , الزنك و فيتامين ب$_{12}$ المتمثل في مصدر الغذاء "كبد البقر البلدي "بمقدار 250 جرام بعد الطهي لكل طالب , تكونت عينه الدراسة من (14) طالب من الفرقة الرابعة - كلية العلوم الزراعية البيئية – جامعة قناة السويس , حيث تم تقسيم الطلاب الي مجموعتين مجموعة ضابطه وعددهم (5) طلاب ومجموعه تجريبية وعددهم (9) طلاب , تم سحب عينه معملية لقياس نسبة الكولين والزنك وفيتامين ب$_{12}$ في بلازما الدم "قبلي" وتم قياس زمن الرجع باستخدام 5 اختبارات علي الكمبيوتر من خلال الانترنت "قبلي" وفقا لجيم ألن. تم الدعم الغذائي باستخدام مصدر الغذاء الطبيعي وهو الكبدة البلدي يوميا لمده 30 يوم ,وتم اعاده سحب عينه معملية لقياس نسبة الكولين والزنك وفيتامين ب$_{12}$ في بلازما الدم "بعدي" وتم قياس زمن الرجع باستخدام 5 اختبارات علي الكمبيوتر من خلال الانترنت "بعدي" , تم تطبيق اختبار (مان وتني يو ,ويلكوكسون) للتحليل الاحصائي حيث كشفت النتائج أن تناول المكملات الغذائية الطبيعية أدي الي تحسن زمن الرجع مقارنه بالمجموعة الضابطة حيث تم أداء العينة بشكل أفضل في التحليلات المعملية عند $(P < 0.01)$ وفقا لنتائج البحث وجدول قياسات اختبارات زمن الرجع عبر الانترنت فإن الكولين والزنك وفيتامين ب$_{12}$ لهما تأثير ايجابي علي تطوير وتحسين زمن الرجع عند $(P < 0.01)$ وبالتالي الادراك والذاكرة .

الكلمات المفتاحية: الكولين – الزنك – فيتامين ب$_{12}$- زمن الرجع .