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The effect of some natural antioxidants supplementation on cognition status in children with learning disabilities

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Abstract

Cognition refers to all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. Polyphenols are powerful antioxidant and regular intake of polyphenol-rich food caused a positive impact on cognitive outcomes. This study investigates the effect of some natural antioxidant (quercetin, caffeic acid, P-coumaric acid and ferulic acid) supplementation in cognition of 27*children aged (7– 13) years in the primary school (Al-Azhar Primary Institutes) with learning disabilities measure which were diagnosed by the psychologist and their teachers. Some forms and tests were used before and after antioxidant supplementation including* Intelligence tests*(*Stanford Penny*), learning disabilities measure (cognition), Personal data,* Anthropometric measurements, and nutritional assessment. *The application of food intervention was carried out by providing one category of meals daily, meal 1 contains (vanilla biscuit with yellow corn meal + fruit cake with cocoa jelly), meal 2 contains (chocolate cupcake with yellow corn meal +fruit cake with red beet roots jelly) and meal 3 contains (chocolate peanut butter biscuits+ vegetables salad) for 3 months frequency. Meals are rich in polyphenols as (quercetin, caffeic acid, P-coumaric acid and ferulic acid) caused* highly significant increase (p≤ 0.01) in the mean value of cognition (23.88±2097) as compared before test (15.11± 2.43). *It was also observed an improvements in some behavioral and nutritional problems. It could be concluded that,* dietary intervention rich in polyphenols may *improve cognition in children with learning disabilities.*

Key words: cognition, polyphenols, quercetin, caffeic acid, p-coumaric acid, ferulic acid.

Introduction

Cognition is defined as the brain's ability to acquire, process, store, and retrieve information,cognition consists of important elements such as attention, perception, memory, motor skills, executive functioning, and verbal and language skills ***(Khera and Rangasamy, 2021).***Cognition is based on reinstatements of external perception and internal states proprioception as well as bodily actions that produce simulations of previous experiences ***(Kiefer and Trumpp, 2012).***Polyphenols (such as phenolic acid and flavonoids) are the group of biologically active compounds in plant-based foods like fruits, vegetables, cereals, and coffee with powerful antioxidant ***(Dragovicuzelac et al., 2007 and Abbas et al.,2017).*** A large number of dietary intervention studies in human subjects ***(Macready et al., 2009)*** and rodents***(Rendeiro et al., 2009),*** in particular those using foods and beverages derived

from grape, tea, cocoa and blueberry ***(Bakoyiannis et al., 2019).*** **(Gonzalo et al., 2022)**observed that a regular intake of polyphenol-rich foods identifies a positive impact on cognitive outcomes as well as improvements in learning, working memory, spatial memory, and memory acquisition and retention.

Quercetin (Q), a ubiquitous flavonoid, has been identified as a promising compound exhibiting neuroprotective potentials against Alzheimer disease at animal ***(Zhang et al., 2016)*** and human ***(Nakagawa et al., 2016))*** level. ***Xia et al., (2015)*** showed that in the case of oxidative stress, an appropriate dose of quercetin can attenuate oxidative stress to improve hippocampus dependent cognition.Caffeic acid, a polyphenolic compound, has been reported to possess potent antioxidant and neuroprotective properties ***(Deshmukh et al., 2016).***It is found in food such as tomatoes, carrots, strawberries, blueberries and wheat **(*Wang et al., 2016). Deshmukh et al., (2016)*** suggest the therapeutic potential of caffeic acid in cognition disorder such as Alzheimer disease.

P-Coumaric acid (p-CA), a phenolic acid can be found in many fruits, vegetables, and cereals, p-CA has gained considerable attention nowadays because of its wide variety of biological activities, including antioxidant ***(Sakamula and Thong-Asa, 2018),*** anti-inflammatory **(Yoon et al., 2014);** anti-apoptotic ***(Guven et al., 2015),*** neuroprotective ***(Oh et al., 2021),*** and memory-ameliorating effects ***(Daroi et al., 2022*)**. Ferulic acid is a phenolic phytochemical with antioxidant and neuroprotective properties and exhibits antiepileptogenic effect and prevents oxidative stress and cognitive impairment induced by pentylenetetrazole kindling **(Hassanzadeh et al., 2017).**This study was conducted to investigate the effectiveness of administring diets rich in some natural antioxidants on the abilities of cognition and nutritional status for primary school children with learning disabilities.

Children and Methods

Materials

Ingredients of prepared Diets (Fruit Cake with cocoa and red beet roots jelly, vanilla biscuit with yellow cornmeal, Chocolate Cupcake with yellow cornmeal, Chocolate peanut butter biscuits, Vegetable Salad) were purchased from the local market.

Children: Twenty-seven children aged (7 – 13) years in the primary school (Al-Azhar Primary Institutes) were diagnosed difficulty cognition by the psychologist and their teachers, were enrolled in the study.

Methods:

Anthropometric measurements: The height of the children was measured to the nearest 0.1 cm**.** The weight in kilograms, was measured by using procedure described by ***(Jelliffe, 1966)*** using bathroom scales. *Body Mass Index (BMI) –for-age is a number calculated from a child's weight and height and evaluated using an age and sex specific growth chart* **(*Must and Anderson, 2003).***

Dietary assessment for the students were evaluated including (the knowledge was obtained from their parents): Diet History Method: Evaluating foods and quantities the child eats during (day, week, month and year). 24 hours recall for one week (before and after diets intervention) were taken then were analyzed by food composition table, at the National Nutrition Institute (NNI, 2006) and compared to their recommended dietary allowance according to **(*Dietary Guidelines for Americans 2020- 2025).*** *Dietary habits for family and children were carried out.*

Diets preparation: The application of food intervention was carried out by providing one category of meals for the day and differ consequently, meal 1: (*Vanilla biscuits with yellow cornmeal + Fruit cake with cocoa jelly*), meal 2: (*Chocolate cupcake with yellow cornmeal + Fruit cake with red beet roots jelly*) and meal 3: (Chocolate peanut butter biscuits+ Vegetables salad) for 3 months.

Method of preparation the different diets formula: *all diets* were prepared with conventional methods with some modifications as follows:

Meal (1): *vanilla biscuit with yellow cornmeal:* all ingredients were weighed, mixed (corn flour 70g, Honey 40 g, butter 30 g, egg 15g, vanilla ½g, baking powder 1g and salt ½ g) then manually kneaded. Dough was cut into various shapes and baked at 180˚C for about 10 minutes and left to cool at room temperature ***(Al-Marazeeq and Angor, 2017).***

Fruit cake with cocoa jelly*:* all ingredients were weighed, (dates 50g, plum 100g, apple 50g, strawberry 50g, gooseberry 100g, orange 50g, peanuts 25g, cocoa 10g, honey 85g and gelatin 15g). The fruits was washed, peeled and cut into small pieces, then stacked, covered with gelatin and placed in the freezer until it freezes. The cocoa jelly was prepared with a large spoonful of gelatin for each cup of water and stirred well, then raised on the fire until it boiled then cooled and sweetened with honey and cocoa stirring well, then pouring it over the frozen fruits and placed in the freezer again until the jelly freezes.

Meal (2): Chocolate cupcake with yellow cornmeal: the method was conducted according to ***(Hassan et al, 2020)*** with some modifications, all ingredients were weighed (corn flour 50g- cocoa 2g- peanuts 5g- vanilla ¼ - salts ¼ - baking powder ½ g) sifted together in a medium mixing bowl. Egg 20g was mixed for 1 minutes by a handled electric mixer, corn oil 20g and milk 25g added to egg and mixed then honey 20g was added and mixed together for 1 minutes. All mixed ingredients were added to dried mixture and poured into bake cups paper then baked at 180°C for 15 min. Baked cupcake cooled at room temperature, then cover the surface with cocoa mixed with honey 15g and peanut.

Fruit cake with red beet roots jelly*:* all ingredients were weighed (dates 50g, chokeberry 5g, banana 50g, grape 50g, strawberry 150g, gooseberry 100g, orange 25g and peanuts 25g- honey 45g- gelatin 15g- dried red beet roots 5g), washed, peeled and cut into small pieces, stacked, covered with gelatin and placed in the freezer until it freezes. The beet jelly was prepared with a large spoonful of gelatin for each cup of water and stirred well, then raised on the fire until it boiled, cooled and sweetened with honey and beets stirring well, then pouring it over the frozen fruit and placing it in the freezer again until the jelly freezes.

Meal (3): *Chocolate peanut butter biscuits: was carried out* according to ***(Al-Marazeeq and Angor, 2017)*** with some modifications all ingredients were weighed, mixed (corn flour 60g, corn bran 4g, cocoa 5g, Honey 65 g, peanuts 25g, butter 25g, egg 15g, vanilla ¼ g, baking powder ½ g and salt ¼ g, white chocolate 20g) then manually kneaded. Dough was cut into verities shape and baked at 180˚C for about 10 minutes and left to cool at room temperature. Chocolate sauce was prepared after turning peanuts into butter. Two pieces of biscuits were pasted with peanut butter and covered with chocolate sauce prepared with cocoa, honey, and white chocolate was placed on the surface.

Vegetable salad: including**,** tomato 50g, cucumber 50g and carrot 70g were chopped into chunks red onion (20g) was chopped, dill (15g), watercress (20g) and coriander (20g) were finely chopped added salt (¼ g) and lemon (2g) ***(Raiz, 2013).***

Sensory evaluation

Cupcakes*:** Forty mothers and fathers of children under the study were asked to evaluate the prepared *Cake* for sensory quality attributes (appearance, texture, color, taste, odor, pore and overall acceptability) ***(Hassan et al., 2020).

Biscuits: The samples were evaluated for desirability in appearance, color, moisture, texture, taste, flavor and overall acceptability using a 9-hedonic scale test as described by ***Larmond, (1991).***

Fruit cake with jelly: The samples were evaluated for desirability in appearance, color, texture, taste, odor, flavor and overall acceptability was evaluated according to ***(Grujić et al., 2007).***

Chemical composition: *The above-mentioned diets were chemically analyzed to determine the chemical composition According to* ***(A.O.A.C, 2020).*** *Total antioxidant (Quercetin, Caffeic acid, P-coumaric acid and Ferulic acid) were analyzed according to the method of* ***(Burda and Oleszek, 2001).***

Clinical Assessment:

Behavioral and physician tests: *These tests were used to measure the behavioral indicators of developmental learning disabilities (Cognition) for primary school students, including (10 items) from (37 axes) according to (Elnagar and Salama, 2015).* Intelligence tests(Stanford Penny) was carried out according to ***(Penny, 2011).****The measure forms were used before starting the study and after 3 months from tested diet intervention.*

Statistical Analysis: The data were expressed as mean ± standard deviation (SD),t test was used to compare results before and after the intervention study**,** P<0.05 was considered statistically significant ***(Snedecor and Cochran, 1980).***

Results

Table (1) shows the intelligence quotient (IQ) for children with learning disabilities before diet intervention was (94.07 ± 3.63) with the minimum IQ was 88 while maximum IQ was 100. The effect of prepared diets rich in some natural antioxidants on abilities of cognition in primary school children with learning disabilities was shown in Table (2). Children that fed in the prepared diets rich in some antioxidants had highly significant increase (P≤ 0.01) in the mean value of cognition (23.88±2097) compared with the initial test (15.11± 2.43).

There is no significant difference in weight for children with cognition impairments before and after the tested diet as shown in Table (3-A). On the other hand, children with learning disability had highly significant difference (p ≤0.01) in height after feeding on the tested diets (133.03 ± 8.79 cm) compared before the test (129.3 ± 8.74 cm). Table (3-B) showed that body mass index for age for normal weight children was 63% before diet intervention but was increased after diet intervention to

66.7%, obesity children before diet was 7.40% compared with after diet was 3.70%. No changes in underweight and overweight children before or after intervention diet.

Table (1) :

Intelligence Quotient for children with difficulty cognition.

	Subject (N)	Minimum	Maximum	Mean± SD
IQ	27	88.00	100.00	94.07 ±3.63

Table (2)

Effect of diets rich in some natural antioxidants on cognition status in children with learning disabilities

	Before test				After test			t	df	Sig.
	N	Mini	Maxi	Mean	Mini	Maxi	Mean			
Cognition	27	10.00	19.00	15.11±2.43	15.00	29.00	23.88±2.97	19.89	26	0.000**

SD: standard deviation.

Table (3-A):

Anthropometric measurements for children with difficult cognition

Parameters	Before	After	t	df	Sig.
Weight(kg)	29.81±1.77	30.87±6.32	0.921	26	0.365 (NS)
Height (cm)	129.3±8.74	133.03±8.79	9.952	26	0.000**

Data are expressed as means ± SD. **: highly significant differences at (P≤ 0.01).

NS: Non Significant.

Table (3-B):

Body mass index for age for children with difficult cognition

Parameters	Before		After	
	N	%	N	%
Underweight	5	18.5%	5	18.5%
Normal	17	63%	18	66.7%
Overweight	3	11.1%	3	11.1%
Obesity	2	7.40%	1	3.70%

Table (4) revealed the appearance score for all tested diets ranged between 9.1-9.7. The texture score ranged between1 8.7-19.6. The internal color score ranged between 9.4- 9.7. The taste score ranged between 18.4-19.6. The odor score ranged between 18.9 -19.6. The moisture score ranged between 19.2-19.6. The pore score for Chocolate and peanut cupcake 18.1. The flavor score ranged between 18.6-19.6. Vanilla biscuits with yellow cornmeal, Chocolate Peanut Butter Biscuits, Fruit cake with beet jelly, Fruit cake with cocoa jelly and Chocolate and peanut cupcake, respectively. General acceptable degree of Vanilla biscuits with yellow cornmeal (97.8), Chocolate Peanut Butter

Biscuits (93.55), Fruit cake with beet jelly (97.3), Fruit cake with cocoa jelly (95.45) and Chocolate cupcake with yellow cornmeal (95).

Table (5) showed the antioxidant contents in prepared diets, quercetin contents in meals was 50 mg, 50.7 mg and 50.1 mg for meal1, meal 2, meal 3, respectively. While caffeic acid contents in meals was 31.5, 30.5 and 30.7 mg respectively. P-coumaric acid content was 32, 30.9 and 30.3 mg, but contents of ferulic acid in meals was 150, 150.4 and 151.6 mg, respectively. Total antioxidants content was 263.5, 262.5 and 262.7 mg, respectively, it was observed that all prepared diet has antioxidant content including quercetin, caffeic acid, p-coumaric acid and ferulic acid.

The chemical composition for prepared meals was shown at Table (6). The energy content for the three prepared diets ranged between 1174 to 748 Kcal, respectively. Protein content reached 21.2 to 13.4 g, respectively. The three prepared diets provide fat from 29.8 to 24.4 g, carbohydrates from 205 to 115g. Calcium content from 192.5 to 149 mg while phosphorus provide 430 to 336mg. magnesium 146-99mg, iron 7.3-6.64 mg, zinc 3.14-2.8, vitamin A 1572-460 µg, Vitamin C provide 128-67 mg.

Table (4)

Sensory evaluation of prepared diets for children with difficulty cognition

Parameters / Diets	Appearance (score =10)	Texture (score =20)	color (score =10)	Taste (score =20)	Odor (score =20)	Moisture (score=20)	Pore (score=20)	Flavor (score=20)	General acceptability
Vanilla biscuits with yellow cornmeal	9.7±0.73	19.6±0.79	9.7±0.68	19.6±0.76	----	19.6±0.80	----	19.6±0.76	97.8±0.92
Chocolate Peanut Butter Biscuits	9.1±0.88	18.75±1.03	9.5±0.67	18.4±1.21	----	19.2±0.96	----	18.6±1.03	93.5±0.62
Fruit cake with beet jelly	9.52±0.81	19.5±0.1.01	9.7±0.55	19.6±0.84	19.6±0.65	----	----	19.4±1.19	97.3±0.81
Fruit cake with cocoa jelly	9.6±0.52	19.25±0.95	9.6±0.57	18.6±0.90	18.9±0.81	----	----	19.5±0.81	95.5±0.65
Chocolate cupcake with yellow cornmeal	9.2±0.88	19.3±0.94	9.4±0.67	19.4±0.87	19.6±0.83	----	18.1±135	----	95±0.88

Data are expressed as means± SD.

Table (5):

Antioxidants contents in prepared diets

Items	Serving size (gm)	Quercetin (mg)	Caffeic acid (mg)	P-Coumaric acid (mg)	Ferulic acid (mg)	Total Antioxidants (mg)
Meal (1): Vanilla biscuits with yellow cornmeal + Fruit cake with cocoa jelly	692	50	31.5	32	150	263.5
Meal (2): Chocolate cupcake with yellow cornmeal + Fruit cake with red beet roots jelly	678	50.7	30.5	30.9	150.4	262.5
Meal (3): Chocolate peanut butter biscuits+ Vegetables salad	447	50.1	30.7	30.3	151.6	262.7

Table (6):

Chemical composition for prepared diets.

Items	Energy (Kal)	Protein (g)	Fats (g)	Carb. (g)	Ca (mg)	P (mg)	Mg (mg)	Fe (mg)	Zn (mg)	V.A (µg)	V.C (mg)
Meal (1):	1174	21.2	29.8	205	149	430	99.5	6.64	3	842	84.3
Meal (2):	986	13.4	25.8	175	167.5	405	146	6.73	3.14	460	128
Meal (3):	748	17	24.4	115	192.5	336	99	7.3	2.8	1572	67

Table (7):

Behavioral problems for children with difficult cognition.

Test / Problems	Before		After	
	N	%	N	%
Memory impairment	27	100	5	18.51
Inattention	27	100	6	22.22
Hyperactivity	19	70.30	10	37
Sleep disorder	15	55.50	10	37
Anger	23	85.10	19	70.30
Violence	20	74	13	48.10
Impulsive	16	59.20	12	44.44

Table (8)

nutrients intake for children with cognition impairment.

Nutrients	Before (%)	After (%)	Sig
Protein	85.11±2.53	106.18±6.08	0.000**
Carb.	70.44±4.34	105.11±6.47	0.000**
Fat	85.11±2.53	106.18±6.08	0.000**
Energy	73.14±3.58	103.81±4.38	0.000**
Calcium	69.44±9.90	86.29±8.05	0.000**
Phosphorus	71.81±9.72	90.00±6.71	0.000**
Iron	73.77±12.17	106.96±10.73	0.000**
Zinc	65.18±14.44	101.74±8.26	0.000**
Mg	62.00±14.56	103.37±5.54	0.000**
Vitamin A	102.00±10.30	238.07±10.65	0.000**
Vitamin C	105.40±8.76	301.29±28.52	0.000**
Vitamin E	81.51±12.62	100.88±10.53	0.000**
Folate	65.22±14.97	72.18±12.80	0.000**

Table (7) revealed behavioral problems for children. Memory impairment, inattention, and hyperactivity before diets intervention were recorded 100%, 100%, and 70.30% but after supplemented tested diets were decreased to 18.51%, 22.22%, and 37%, respectively. Sleep disorder before supplemented diets were 55.5% and lowered after tested diets to 37%. Before tested diets behavioral problems anger, violence, aggressiveness, and impulsive were recorded 85.10%,74%,33.30% and 59.20% respectively, while these levels were lowered after tested diets supplementation to 70.30%,48.10%, 18.51% and 44.44%, respectively. It was clear that prevalence of behavioral problems was very high such as (memory, attention, violence, hyperactivity, impulsive and sleep disorder). However, these problems were lowered after diets intervention.

The percent of nutrients intake of the 24-hour recall were shown in Table (8). The results revealed highly significant increase (p≤0.01) in protein, carbohydrate, fat, energy (85.11±2.53, 70.44±4.34, 85.11±2.53 and 73.14±3.58 %) VS (106.18±6.08, 105.11±6.47, 106.18±6.08 and 103.81±4.38%), respectively. Also, the results revealed a high significant increase in minerals intake for (Calcium, phosphorus, iron, zinc and magnesium) before diet intervention (69.44±9.90, 71.81±9.72, 73.77±12.17, 65.18±14.44 and 62.00±14.56%)Vs (86.29±8.05, 90.00±6.71, 106.96±10.73, 101.74±8.26 and 103.37±5.54%), respectively. In addition (vitamin A, vitamin c, vitamin E and folate) before diet intervention were recoded (102.00±10.30, 105.40±8.76, 81.51±12.62 and 65.22±14.97) VS (238.07±10.65, 301.29±28.52, 100.88±10.53 and 72.18±12.80%), respectively.

Discussion

Healthy eating and active lifestyles are associated with children's healthy weight and cognition development. This study examines the effectiveness of administration diets rich in some natural antioxidants to improve the abilities of cognition and nutritional status for primary school children with learning disabilities. Children suffering from difficulty cognition enjoyed with meditate IQ score (94.07) with (Stanford Penney) (Table 1). ***Liang and Li, (2019)*** reported that the mean IQ score was 95 in learning disability children compared with the mean IQ score was109 in normal children.The obtained results indicated that after diet intervention rich in quercetin, there were an improvement in children cognition, these results agreed with ***(Nishimura et al., 2017)*** who observed that feeding on quercetin-rich onions improves cognitive function and reducing cognitive decline in elderly people, another results found that quercetin could improve spatial learning and memory impairment displayed by aging mice ***(Li et al., 2021). Yang et al., (2020)*** suggested that quercetin supplementation might be beneficial for improving cognitive function in elderly subjects with high consumption of dietary advanced glycation end products such as grilling, frying, and broiling of food.

Caffeic acid caused an improvement of children cognition this result agree with **(*Wang et al., 2016)*** who suggested that Caffeic acid significantly rescued learning deficits and increased cognitive function in the rats with Alzheimer's disease. Alzheimer's is a disease affecting mostly the older population leading to the deterioration of cognitive capabilities and the neuroprotective and antioxidative potential of caffeic acid in intracerebroventricularly injected Colchicine-induced sporadic model of AD ***(Raviteja et al., 2021).***

P-coumaric acid improve cognitionin this study, these results are in the same line with **(*Kim et al., 2017)*** who showed that p-coumaric acid improved electrophysiological and cognitive functional deterioration by scopolamine, it may have regulatory effects on central cholinergic synapses and is expected to improve cognitive problems caused by abnormality of the cholinergic nervous system. The findings suggest that both anti-oxidative and anti-inflammatory properties of p-CA may be the underlying mechanisms behind its beneficial effect in preventing neuronal loss and improving cognitive and non-cognitive deficits associated with AD ***(Ghaderiab et al., 2022).*** In addition, ***Daroi et al., (2022)*** demonstrated the significant neuroprotective effect of PCA against D-gal induced oxidative stress, neuro inflammation, cognitive impairment and apoptosis. Moreover**,** FA protects against Pb-induced offspring's cognitive deficits, suggesting that it is a promising candidate for the treatment of Pb toxicity ***(Yua et al.,2021). Tsai et al., (2015*)** suggest that FA reduced the progression of cognitive deficits by activating central muscarinic and nicotinic receptors and anti-oxidant enzymes.

The obtained results showed that children with normal weight, low weight, or overweight suffer from weakness memory as shown in***. De Rodrigues et al., (2006)*** showed that school children born with very low birth weights exhibited increased risk of learning disabilities (difficulty cognition, memory weakness and Intention) when compared with those born at full term.

A stronger inverse association between increased intake of higher-fiber, lower-Glycemic Load vegetables and weight change, consistent with experimental evidence suggesting an influence of these factors on satiety, glucose and insulin responses, fat storage, and energy expenditure ***(Bertoia et al., 2015).*** Ferulic Acid could be beneficial in lowering the risk of high fat diet -induced obesity via modulation of enzymatic, hormonal and inflammatory responses ***(De Melo et al., 2017).Erejuwa et al., (2017)*** suggested that 1.0 g of honey/ kg BW of rats produced beneficial effects on obese rats, while high doses of honey (2 or 3 g of honey /kg BW) did not increase BMI and it can be suggested that honey has a potential to serve as a viable functional food or a substitute for artificial/synthetic sweeteners in obese diets. These results are matched with the obtained results that indicated a significant increase of carbohydrate, fat, protein intake, while the BMI didn't change due to diets intervention.Finally, it could be concluded that dietary intervention rich in diets rich in polyphenols could *improve and enhance cognition status in children with learning disabilities.*

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تأثير التدعيم ببعض مضادات الأكسدة الطبيعية علي حالة الإدراك لدي الأطفال ذوي صعوبات التعلم

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الملخص العربي

يشير الإدراك إلى جميع العمليات التي يتم من خلالها تحويل المدخلات الحسية ، وتقليلها ، وتفصيلها ، وتخزينها ، واستعادتها ، واستخدامها.تعد مادة البوليفينول من مضادات الأكسدة القوية ، كما أن تناول الطعام الغني بالبوليفينول بشكل منتظم يؤدي إلى تأثير إيجابي على الإدراك. تهدف هذه الدراسة الي معرفة تأثير بعض مضادات الأكسدة الطبيعية (كيرسيتين ، وحمض الكافيك ، وحمض الكوماريك ، وحمض الفيروليك) علي الإدراك لدى 27 طفلاً تتراوح أعمارهم بين (7-13 سنة) في المدرسة الابتدائية (معاهد الأزهر الابتدائية) مع قياس صعوبات التعلم التي تم تشخيصها من قبل الأخصائي النفسي ومعلميهم.تم استخدام بعض النماذج والاختبارات قبل وبعد اعطاء مكملات مضادات الأكسدة بما في ذلك اختبارات الذكاء (ستانفورد بيني) وقياس صعوبات التعلم (الإدراك) والبيانات الشخصية وقياسات الأنثروبومترية والتقييم الغذائي. تم تنفيذ تطبيق التدخل الغذائي من خلال تقديم فئة واحدة من الوجبات اليومية ، الوجبة الأولى تحتوي على (بسكويت الفانيليا مع دقيق الذرة الأصفر + كعكة الفاكهة مع جيلي الكاكاو) ، الوجبة الثانية تحتوي على (كب كيك الشوكولاتة مع دقيق الذرة الصفراء + كعكة الفاكهة مع جيلي البنجر الأحمر) الوجبة الثالثة تحتوي على (بسكويت شوكولاتة زبدة الفول السوداني + سلطة خضروات) لمدة 3 أشهر. أدت تناول الوجبات الغنية بالبوليفينول مثل (كيرسيتين ، وحمض الكافيك ، وحمض الكوماريك P ، وحمض الفيروليك) الي حدوث زيادة معنوية عالية ($p \leq 0.01$) في متوسط قيمة الإدراك (2097 ± 23.88) مقارنة قبل الاختبار (15.11 ± 2.43). وأيضا تحسنت بعض المشاكل السلوكية والتغذوية ، وأظهرت النتائج أن التدخل الغذائي الغني بالبوليفينول يحسن الإدراك لدى الأطفال الذين يعانون من صعوبات التعلم.