



THERAPEUTIC EFFECT OF BREAD FORTIFIED WITH WHITE TEA ON EXPERIMENTAL INDUCED DIABETES RATS WITH STUDY CHEMICAL AND SENSORY EVALUATION OF BREAD

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Abstract

The prevalence of diabetes mellitus has been rapidly increasing in the world, White Tea is manufactured only from the buds or first leaves of Camellia Sinensis that are plucked and dried with minimal processing. This study was designed to investigate evaluate the chemical composition, sensory evaluation and Freshness properties of white bread fortified with white tea. Also, investigate the therapeutic effect of using bread fortified with white tea on experimental induced diabetes rats. Bread samples were prepared with replacement of wheat flour (72% extraction) by 2,4, 6 and 8% white tea powder, The freshness of bread samples was tested at 24, 48 and 72 hours of storage at room temperature by alkaline water retention capacity, The rats were divided into six groups, the first group fed on a basal diet and considered as negative control. The second group induced diabetic fed on basal diet and namely as positive control. The other four groups administrated white bread containing 2% white tea powder (2% WTP) , 4% WTP, 6% WTP and 8% WTP. Results clearly revealed that the bread made using wheat flour (72% extraction) which fortified by 2, 4 and 6% WTP slightly decrease the protein, fat, fiber and ash contents than that found in control bread. The tested bread blends fortified with 8% WTP showed the low consumer acceptable with respect to all organoleptic properties, Loss of freshness of fortified bread decreased by increasing the level of white tea powder at 2, 4, 6 and 8% at 24, 48 and 48 hour, respectively. Total cholesterol, triglycerides, LDL cholesterol, VLDL-cholesterol levels uric acid and urea nitrogen were significantly decreased in all the tested diets compared with diabetic control. The experimental groups gave a significant decrease in liver enzymes AST and ALT activities as a result of oxidative stress, all experimental groups give improvement in glucose level, the highest decrease in glucose levels was found with 8% WTP (97.176).

Keywords- Bread Fortified, White tea, Diabetes, Sensory evaluation.

I. INTRODUCTION

The prevalence of diabetes mellitus has been rapidly increasing in the world. Diet plays a key role in the treatment of diabetes and proper nutrition is vital to prevent diabetes complications (**Park and Ahn, 2007**). However, it is not an easy task to follow diabetic diet prescription and the compliance with diabetic diet recommendations is reported to be very poor (**Woo et al., 2006**). Diabetes mellitus is a descriptive term covering a heterogeneous group of chronic metabolic disorder, characterized by elevated blood glucose concentration. The complications result chiefly from the effect of diabetes on the arterial and nervous systems. They include diabetic retinopathy which may lead to blindness, diabetic neuropathy potentially resulting in kidney failure, and foot ulceration which may lead to gangrene. In addition to these specific diabetes related complications, there is a substantially increased risk of cardiovascular disease, kidney disease, macrovascular disease and atherosclerosis, liver disease and a

variety of debilitating neuropathies that diminish the quality of life and life expectancy of the patients in people with diabetes (**Mann and Truswell, 2000**) and (**Kelly et al., 2003**). In 1997, an estimated 124 million people worldwide had diabetes, 97% of these having type 2 diabetes, otherwise known as non-insulin dependent diabetes mellitus (NIDDM), or adult population, afflicting approximately 17% of people aged greater than 65 years (**Amos et al., 1997**).

The imbalance of the circulating lipid profile is a consequence of diabetes mellitus (**Colca et al., 1991**). In the scientific literature, it is a subject of ongoing debate whether polyphenols and or xanthenes can be utilized to modulate different levels of the adipocyte life cycle (**Rayalam, et al., 2008**). In recent years, functional foods have appeared as new means to help maintain proper nutrition in patients with chronic diseases such as diabetes. White tea is prepared from very young tea leaves or buds covered with tiny, silvery hairs, which are harvested only once a year in the early spring. White tea is steamed and dried immediately after picking to prevent oxidation, giving it a light, delicate taste. In spite of numerous data about the phenolic constituents, antioxidant activity and ameliorating effects of green and black tea on human health, little is known in this sense about white tea, which is the rarest and the least processed tea. (**Rusak et al., 2008**).

White tea is lower in caffeine than green tea, white tea is much higher in antioxidants, esp. catechins than green tea and white tea has a higher anti-mutagenicity action compared to green tea. From compositional data available it can be stated that the first two claims are completely nonsense. Currently there is a great marketing and public interest for white tea. As there is a high demand but low supply it has sometimes been suspected that more white tea is now sold than is grown! (**Hilal and Engelhar, 2007**).

White tea, which has received little if any attention for its health benefits represents the least, processed of teas in that it goes through steaming and drying without a prior withering stage. Because the catechins are converted to theaflavins, thearubigins, and more complex polyphenols as green tea is processed into oolong and black teas, and the catechins generally are assumed to be more active based on their antioxidant and other protective properties (**Wiseman, et al. , 1997**) and (**Lee, et al., 1995**). A combination of these different bioactive compounds is naturally present in White Tea extract. In contrast to Green- and Black Tea, White Tea is manufactured only from the buds or first leaves of *Camellia Sinensis* that are plucked and dried with minimal processing. Therefore, the concentrations of epigallocatechin-3-gallate (EGCG) and also methylxanthines (like caffeine) are enriched in White Tea compared to Green- or Black Tea (**Hilal and Engelhar, 2007**).

Bread has been a staple of the human diet. It is so influential that even in today's times, a shortage of bread is synonymous with hard times (**Scanlon, 2001**). In recent years, with the increasing urbanization as well as the advancement in baking technology and changing food habits, the bakery food products such as bread are now becoming popular in the most developing countries (**Agrawal, 1990**). White bread is a popular part of the daily diet. With respect to the longevity of commercial white bread's storage, ways and means should be explored to extend its shelf life. The basic criteria for the quality of bakery products are health safety and optimum sensory properties. The durability of bakery products with medium and high humidity content is often limited by the growth of molds (**Hozova et al., 2002**).

This study was designed to investigate: 1) evaluate the chemical composition, sensory evaluation and Freshness properties of white bread fortified with white tea.

2) Therapeutic effect of using bread fortified with white tea on experimental induced diabetes rats.

II. MATERIALS AND METHODS

Materials:Wheat flour (*Triticum aestivum*, 72% extraction) and white tea powder were purchased from local market of Cairo, Egypt. Biological parameters determination kits: total cholesterol, HDL, LDL,

VLDL, urea, uric, AST and ALT, and blood glucose were obtained from Biodignostic Company, 29 El Tahreer Street, Dokki, Giza, Egypt. Alloxan (the diabetes mellitus induced drug in rats) was obtained from Sigma Company, USA.

Methods

Preparation of white bread: Bread samples were prepared with replacement of wheat flour (72% extraction) by 2, 4, 6 and 8% white tea powder according to the method described by Pollock, and Geddes (1960).

Chemical analysis: Moisture, protein, ether extract, crude fiber and ash contents of white bread were determined according to the methods of A.O.A.C. (2000). The total carbohydrates were calculated by difference. Organoleptic evaluation of bread All bread samples were evaluated for their sensory characteristics, i.e., appearance, taste, aroma, crust color, and separation of layer by well ten experienced panelists of food technology institute according to the method described by El-Farra et al., (1982).

Freshness of bread

The freshness of bread samples was tested at 24, 48 and 72 hours of storage at room temperature by alkaline water retention capacity (AWRC) according to method of Yamazaki (1953), as modified by Kitterman and Rubenthaler (1971).

The experimental Design:

Adult male albino rats (36), weighed 190 ± 10 g. Animals were housed at the Animal House, Food Technology Research Institute (FTRI), Giza, Egypt, under normal healthy conditions for one week and fed on the (basal diet). The basal diet composed of casein (12%), cellulose (5%), vitamins mixture (1%), salts mixture (4%), corn oil (5%) and corn starch (73%). The basal diet formulation was performed according to A.O.A.C (2006).

Experimental diabetes was induced by administration of alloxan monohydrate (Sigma, 32 mg/kg of body weight) dissolved in citrate 0.01 M, pH 4.5, injected into the penile vein. After this procedure, the animals were returned to their cages and received, in the first 24 hours post-alloxan, a solution of water and glucose (15%), in addition to feed (Luciano and Lima, 1997). Two weeks after administration of the drug, the blood glucose level of the animals was tested for evidence of a diabetic state. The animals could be considered diabetic when the serum glucose level equal to or greater than 190 mg/dl.

The rats were randomly divided into six groups (six rats for each one), the first group fed on a basal diet and considered as negative control. The second group induced diabetic fed on basal diet and namely as positive control. The other four groups administrated white bread containing 2% white tea powder (2% WTP), 4% white tea powder (4% WTP), 6% white tea powder (6% WTP), 8% white tea powder (8% WTP).

At the end of the experimental period (8 weeks), blood sample were collected for serum separation to estimate serum total cholesterol, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C), very low-density lipoprotein cholesterol (VLDL-C) and triglycerides (TG) were determined according to the methods of Roeschlau et al. (1974); Assmann (1979); Hatch and Lees (1968) and Uwajima et al. (1984), respectively. Uric acid in serum was determined according the method of Barham and Trinder (1972). Urea was determined in serum as carried out by Fawcett and Soctt (1960). Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities were colorimetrically determined according to the method of Bergmeyer and Harder (1986). Blood glucose was determination according to the procedure of Trinder (1969).

Statistical Analysis

The Obtained data of sensory and biological evaluation were statistically analyzed according to Gomez and Gomez (1984). Least significant difference (LSD) test was done to compare a pair of group means. The level of statistical significance was set at $p < 0.05$.

III. RESULTS AND DISCUSSION

Table (1): Chemical composition of white bread fortified with white tea powder at 2, 4, 6 and 8% level (% on dry weight basis)

Groups	Protein	Ether extract	Crud fiber	Ash	Total Carbohydrate*
Control	11.81	1.90	0.19	3.30	82.80
Bread with 2% WTP	11.56	1.89	0.18	3.23	83.14
Bread with 4% WTP	11.35	1.83	0.18	3.19	83.45
Bread with 6% WTP	11.12	1.80	0.18	3.13	83.77
Bread with 8% WTP	10.86	1.78	0.18	3.08	84.10

*Total carbohydrates were calculated by difference

Control (-): Control negative **Control (+):** Control positive **2%WTP:** 2% White Tea Powder

4%WTP: 4% White Tea Powder **6%WTP:** 6% White Tea Powder **8%WTP:** 8% White Tea Powder

This investigation aimed to fortified white bread with different levels of white tea powder (WTP) at 2,4,6 and 8%.The study also aimed to evaluate the chemical composition, sensory evaluation and Freshness properties of white bread and the biological effect of bread samples on diabetic status and measurement of some biological parameters. From the data presented in Table (1), it could be noticed that bread made using wheat flour (72% extraction) which fortified by 2,4 and 6% WTP slightly decrease the protein, fat, fiber and ash contents than that found in control bread. These results agreed with **Carpenter (1940)** who reported that white bread contained 1.7% fat, 9.8%protien and 0.78% ash. Bread fortified by 8% white tea powder decrease the protein, fat and ash contents (10.86%, 1.78% and 3.08) respectively, On contrary, total carbohydrates content was increased compared with either tested blends white bread and control bread.

Table (2): Organoleptic characteristics of the manufactured white bread:

Treatments	Taste (10)	Color (10)	Odor (10)	Separation of layer (10)	Appearance (10)
Control	9.55 ^a	8.66 ^a	9.08 ^a	9.33 ^a	9.25 ^a
Bread with 2% WTP	9.35 ^a	8.64 ^a	8.65 ^a	8.87 ^a	9.15 ^a
Bread with 4% WTP	8.58 ^b	8.46 ^a	8.30 ^b	9.18 ^a	8.70 ^b
Bread with 6% WTP	8.00 ^c	7.33 ^b	8.17 ^c	9.20 ^a	8.00 ^c
Bread with 8% WTP	7.8 ^d	7.00 ^c	7.80 ^d	8.66 ^a	8.15 ^c

Each value (an average of three replicates) within the same column, followed by the same letter is not significantly different at <0.05.

Control (-): Control negative **Control (+):** Control positive **2%WTP:** 2% White Tea Powder

4%WTP: 4% White Tea Powder **6%WTP:** 6% White Tea Powder **8%WTP:** 8% White Tea Powder

The organolyptic properties of white bread fortified by 2, 4, 6 and 8% white tea powder (WTP) are presented in table (2). The results showed that bread blends produced with 2% and 4% WTP scored the highest, regarding to organolyptic properties compared to the other fortified levels (6 and

8%). While, separation of layer evaluation of the tested bread showed no significant difference in all tested samples. However, organoleptic acceptability drops with increasing percentage of WTP fortified level to 8%, which showed the lowest score of taste and odor attributes and was significantly differed than the other tested bread. In general, the tested bread blends fortified with 8% WTP showed the low consumer acceptable with respect to all organoleptic properties. Also, the tested bread showed that 2% and 4% WTP blends were the most preferable by the panelist. These results agreed with **Sharma and Zhou (2011)** who reported that tea antioxidants have potential health benefits, not only as an antioxidant agent but also as anti-arteriosclerotic, anti-carcinogenic, and antimicrobial agents. They may contribute to reducing risks of chronic diseases and cancer, promoting oral health, and prolonging shelf life of food products without damage to their organoleptic or nutritional qualities.

Table (3): Alkaline water retention capacity (AWRC) of the produced stored white bread:

White bread	Alkaline water retention capacity (%)				Loss of freshness (%)		
	AWRC after specific time (in hours)						
	Zero time	24	48	72	24	48	72
Control (100% WF)	297	268	254	221	9.76	14.48	25.58
Bread with 2% WTP	282	235	213	185	16.67	24.46	34.40
Bread with 4% WTP	284	250	220	190	11.97	22.54	33.10
Bread with 6% WTP	294	264	230	206	10.20	21.76	29.93
Bread with 8% WTP	296	268	237	216	9.46	19.93	27.02

Control (-): Control negative **Control (+):** Control positive **2%WTP:** 2% White Tea Powder
4%WTP: 4% White Tea Powder **6%WTP:** 6% White Tea Powder **8%WTP:** 8% White Tea Powder

Alkaline water retention capacity (AWRC) is a simple and quick test to follow staling of bread. The staling of bread can be defined as the decrease in consumer acceptance caused by changes in the crumb and crust undue to microbiological action (**Betchel, 1955**). Higher values of AWRC mean higher freshness of bread. The changes occurring in freshness characteristics of white bread at zero time and after 24, 48 and 72 hours of storage at room temperature are shown in Table (3). It can be observed that control bread was fresher than all tested bread under the same conditions; consequently, the staling rate was increased for the later. The freshness reductions were 9.76%, 14.48% and 25.58% for control bread at 24, 48 and 72 hour, respectively. This means that tested bread staled faster than the wheat bread sample. This might be due to the loss of moisture content in the former than the later. Data in the same table show that, bread fortified with 8% white tea powder more freshness than the all tested bread, the freshness reductions were 9.46%, 19.93% and 27.02% at 24, 48 and 72 hours, respectively. Loss of freshness of fortified bread decreased by increasing the level of white tea powder at 2, 4, 6 and 8% at 24, 48 and 48 hour, respectively. The results of **Wang et al., (2006)** observed that most of tea catechins remained in the dough after mixing; there was about 84% total tea catechins retained in bread after baking and during its shelf life in ambience. Also, the results of **Li et al., (2011)** could explain the above mentioned values; they stated that the stability of catechins in green tea powders is important for product shelf life and delivering health benefits. Furthermore, **Sharma and Zhou (2011)** reported that the stability of green tea catechins is a function of the effects of pH, oxygen concentration, etc. The biscuit system is a complex matrix having both solid and aqueous phases, with sugar, fat, leavening agents and other ingredients added to it. Also the temperature, moisture and water activity profiles during biscuit baking are dynamic rather than static.

Table (4): Effect of bread fortified with white tea powder on lipid fractions in diabetic rats:

Parameters Groups	Lipid Fractions (Mg/dl)				
	Cholesterol Mean±SD	Triglycerides Mean±SD	HDL Mean±SD	LDL Mean±SD	VLDL Mean±SD
Control (-)	75.790±0.0606 ^E	41.310±0.898 ^E	51.086±0.867 ^A	18.176±0.763 ^D	8.330±0.280 ^D
Control(+)	143.590±1.328 ^A	86.303±0.625 ^A	32.830±0.327 ^C	92.210±1.081 ^A	18.053±0.886 ^A
2%WTP	109.096±0.990 ^B	57.766±1.480 ^B	44.063±2.060 ^B	45.227±0.652 ^B	10.040±0.246 ^C
4%WTP	106.676±1.985 ^C	55.526±0.938 ^C	44.623±1.030 ^B	44.843±1.484 ^B	11.076±0.901 ^C
6%WTP	105.386±1.025 ^C	51.360±0.630 ^D	44.506±1.391 ^B	46.870±0.772 ^B	12.410±0.435 ^B
8%WTP	81.513±1.452 ^D	51.123±0.897 ^D	45.256±0.939 ^B	28.120±0.939 ^C	10.640±0.556 ^C

Mean with the same letter in each column are not significant different (P<0.05).

Control (-): Control negative **Control (+):** Control positive **2%WTP:** 2% White Tea Powder

4%WTP: 4% White Tea Powder **6%WTP:** 6% White Tea Powder **8%WTP:** 8% White Tea Powder

Biological experiment including total cholesterol, HDL, LDL, VLDL, urea, uric acid, AST and ALT, and blood glucose were carried out on rats fed on white bread fortified with white tea powder at 2, 4, 6 and 8%. Data in table (4) show that there were significant changes in impact of all the tested diets under investigation on both of serum total cholesterol, triglycerides, HDL, LDL, VLDL amounts either in diabetic control or healthy (normal rats). From data in Table (4), it could be observed that total cholesterol, triglycerides, LDL cholesterol and VLDL-cholesterol levels was significantly decrease in all the tested diets compared with diabetic control. There are also reports indicating that drinking tea lowers total cholesterol levels, as well as improves the ratio of good cholesterol (HDL) to bad cholesterol (LDL) (**Cheng, 2006**).

These results confirmed with (**Friedman et al, 2005**) who reported that, Catechins, another group of antioxidants, have been found to reduce cholesterol, and white tea is teeming with them. Cholesterol is a special type of fat and is necessary for health. White tea increases the good cholesterol while decreasing the bad. This helps prevent hardening of the arteries and blockage of blood flow. Serum HDL-cholesterol level was significantly increased in all the tested diets compared with diabetic control. Meanwhile, there was no significant difference between all the tested diets under investigation. Moreover, increasing the fortified level to 8% of WTP showed significant reduction in LDL level compared with all tested diets but higher compared with diabetic control. **Wolever et al. (2003)** who reported that, LDL particle size is reduced and HDL-TG increased in insulin resistant and diabetic subjects. Since there is controversy about the effects of high carbohydrate diets on cardiovascular risk in subjects with diabetes. In vitro studies have shown LDL oxidation to be inhibited by extracts of green and black tea (**McKay and Blumberg 2002**). Also, these results confirmed with. One of the proposed mechanisms for the possible protective effect of tea against cardiovascular diseases is the inhibition of the oxidation of LDL (**Wiseman et al., 1997**).

Table (5): Effect of bread fortified with white tea powder on liver functions (IU/L), serum uric acid and urea nitrogen levels (mg/dl) in diabetic rats:

Parameters Groups	Uric acid Mean ± SD	Urea nitrogen Mean ± SD	AST Mean ± SD	ALT Mean ± SD
Control (-)	1.490±0.157D	14.840±0.918C	43.496±1.140E	46.400±0.701D
Control(+)	2.213±0.041A	23.306±0.736A	57.376±1.305A	54.673±0.582A
2%WTP	1.903±0.737B	16.700±0.458C	48.230±1.301C	42.926±1.726B
4%WTP	1.923±0.058B	19.200±0.608B	50.703±0.513B	41.003±0.890C
6%WTP	1.566±0.072CD	15.466±0.709C	45.923±1.105D	38.776±0.585C
8%WTP	1.760±0.115CB	15.870±0.950C	51.343±1.171B	43.043±2.608B

Mean with the same letter in each column are not significant different (P<0.05).

Control (-): Control negative **Control (+):** Control positive **2%WTP:** 2% White Tea Powder
4%WTP: 4% White Tea Powder **6%WTP:** 6% White Tea Powder **8%WTP:** 8% White Tea Powder

AST: Aspartate amine transferase **ALT:** Alanine amine transferase.

Table (5) shows the effect of bread fortified with white tea powder on serum uric acid and urea nitrogen levels in diabetic rats. Uric acid and urea nitrogen levels were significantly increased in diabetic rats compared with control (-) (normal group) all experimental groups administrated bread fortified with white tea gave significant decrease in uric acid and urea nitrogen when compared with control (+) group, the highest decrease found in group which administered 6 % WTP followed by group 8 % WTP.

Data presented in table (5) showed the effect of bread fortified with white tea powder on liver functions in diabetic rats, control (+) (diabetic rats) gave significant increase in Aspartate amine transferase (AST) and Alanine amine transeferase (ALT) when compared with control (-) (normal rats), all experimental groups give significant decrease in AST and ALT when compared with control (+). From table (6) it could be noticed that the experimental groups gave a significant decrease in liver enzymes AST and ALT activities as a result of oxidative stress at the end of the experimental period which reduced liver functions. Also, ALT gave significant decrease when compared with normal rats (control (-) group). The lowest significant decrease in (AST) and (ALT) was found as a result of administering 6% WTP. Recent findings suggest that regular intake of green tea may reduce the carcinogenic risk posed by an environmental pollutant, pentachlorophenol (**Umemura et al., 2003**). Green tea drinking decreased the risk for the development of liver cancer by 78% among alcohol drinkers and 43% among cigarette smokers (**Mu et al., 2003**). The administration of tea polyphenols and tea pigments in drinking water caused decrease in the number and area of GST-P-positive foci in liver rats (**Jia et al., 2002**). Our results agreed with **Chung et al. (1998)** who reported that A significant decrease in liver tumors (from 34–12%) in rats receiving 2% black tea was reported. Inhibitory effects of individual tea catechins on hepatic preneoplastic GST-positive (**Matsumoto et al., 1996**). In a study, GTP inhibited the development of heterocyclic amine (**Hirose et al., 1995**).

Table (6): Effect of bread fortified with white tea powder on serum glucose levels (mg/dl) in diabetic rats:

Parameter Groups	Glucose level Mean ± SD
Control (-)	86.910±1.670D
Control(+)	112.943±5.451A
2%WTP	108.376±1.101A
4%WTP	108.293±1.255A
6%WTP	103.376±1.101B
8%WTP	97.176±1.050C

Mean with the same letter in each column are not significant different (P<0.05).

Control (-): Control negative **Control (+):** Control positive **2%WTP:** 2% White Tea Powder

4%WTP: 4% White Tea Powder **6%WTP:** 6% White Tea Powder **8%WTP:** 8% White Tea Powder.

Effect of bread fortified with white tea powder on serum glucose levels in diabetic rats is mentioned in table (6). Diabetic rats (control (+)) resulted in a significant increase in serum glucose levels compared with control (-) group. There was insignificant improve in glucose serum levels in groups which administered 2% WTP and 4%WTP was (108.376) and (108.293) respectively when compared with control (+) group. While, administering diabetic rats with 6 % WTP and 8% WTP showed a significant reduction in glucose levels when compared with control (+). The highest decrease in glucose levels was found with 8% WTP (97.176) at the end of the experiment when compared with control (+) group. The present findings agree with those obtained by **Daisuke et al, (2008)** who found that, treatment of mice with streptozotocin induced a progressive hyperglycemia. Concerning the effect of green tea on blood glucose level and serum insulin level. **Swen et al., (2006)** reported that, green tea has antidiabetic effect in rodent models in which EGCG, improved oral glucose tolerance and decreased blood glucose level in rats. Moreover, green tea significantly reduced the blood glucose level of hyperglycemic mice (**Haixia et al, 2005**). Furthermore, these results come in accordance with those obtained by **Sabu et al, (2002)** who found that, green tea was able to decrease blood glucose concentration in diabetic rats injected with alloxan. Several known compounds found in tea were shown to enhance insulin with the greatest activity due to EGCG followed by ECG, tannins and theaflavins. Caffeine, catechin and EC displayed insignificant insulin-enhancing activities. Addition of lemon to the tea did not affect the insulin-potentiating activity EGCG has been found to increase insulin sensitivity and mayrepair damaged beta cells (**McKay and Blumberg (2002) and Anderson and Polansky (2002)**).

IV. CONCLUSION

Based on our results, we conclude that the intake of bread fortified with white tea succeeded in reducing Total cholesterol, triglycerides, LDL cholesterol, VLDL-cholesterol levels uric acid and urea nitrogen. Also, improve liver enzymes AST and ALT activities. The results showed clear improvement in glucose level. Therefore, it could be recommended that the using of white tea should be ingested as natural herbs.

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