

EFFECT OF TEA DRINK ON BODY WEIGHT GAIN OF RATS AND THE BIOAVAILABILITY OF SOME MINERALS

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ABSTRACT

In this study, the results showed that both decoction tea and infusion tea significantly reduced the body weight growth in the tea groups as compared to the control group. The percentage of body weight gain of control group was 58.82% while of tea group was 13.36-35.18%. The addition of milk to decoction tea kept the body weight gain near the same level as control group (50.64%). Also, data showed that the tea significantly reduced nonheme iron, zinc and copper concentrations in the blood as well as in the liver and spleen of rats. On the other hand, decoction tea received two hours after meal significantly increased nonheme iron and calcium in the blood of rats. Fine decoction tea increased Mg and Ca in the blood of rats while tea in general reduced reserve elements under investigation in liver and spleen.

INTRODUCTION

It was reported that the tea has a potent inhibitory effect on absorption of nonheme iron (Disler *et al.* 1975, Rossander *et al.* 1979 and Hollberg and Rossander, 1982). The absorption of nonheme iron is reduced from 0-80% when tea is given with test meals (Derman *et al.* 1977 and De Alarcon *et al.* 1979).

Disler *et al.* (1975) demonstrated that iron absorption from a meal was reduced by 87% when tea was included. Coffee is another beverage that is often consumed with meal. Derman *et al.* (1977) observed a 37% reduction in iron absorption when coffee was added to a meal containing maize. Brown *et al.* (1990) reported that many popular beverages such as tea and coffee also constitute an important source of iron phenolic groups such as tannic, gallic, chlorogenic acid or catechuic tannin compounds, these compounds were considered to be responsible for the reduced bioavailability of nonheme iron from foods.

Hamdaoui *et al.* (1995) stated that the administration of ascorbic acid (20 mg) in a tea decoction (100 mg tea/ml) completely counteracted the inhibiting effect of tea and significantly improved the nonheme iron absorption from Tunisian food (couscous).

The aim of this study is to evaluate the influence of coarse and fine decoction tea and infusion tea taken for 21 days, time of tea drinking and milk addition to tea on body weight gain, nonheme iron, zinc, calcium, phosphorous, magnesium and copper concentrations in blood, liver and spleen.

MATERIALS AND METHODS

Animals and diet:

Seventy male albino rats (average weight 80 gm) divided to 7 groups were fed for 21 days of basal diet, A.O.A.C. (1995) which contains 10% casein, 10% corn oil, 5% cellulose, 4% salt mixture, and 1% vitamin mixture and 70% corn starch. During experimental period rats (except control group) received 10 ml of tea (2 gm/100 ml demineralized water) orally as follow:

Group 1: control group received demineralized water, Group 2: received infusion tea directly after meal, Group 3: received decoction tea (boiled for 5`) directly after the meal, Group 4: received decoction tea (boiled for 15`) directly after the meal, Group 5: received decoction tea (boiled for 15`) 2 hours after the meal, Group 6: received decoction tea (coarse tea boiled for 15`), Group 7: received decoction tea plus milk 50% v/v (tea boiled for 15`, cooled and milk was added). All groups received tea directly after meal except group 5 which received tea after 2 hours. Every day, each rat was given 7-10 ml demineralized water before tea intake (about 10 min) to prevent dehydration.

Preparation of tea:

Tea (decoction and infusion) was prepared daily, infusion tea was prepared by adding 2 gm of tea (Lipton, fine powder) to 100 ml of boiled water and filtered, while decoction tea was prepared by boiling 2 gm tea (Lipton fine or coarse) in 100 ml demineralized water for 5` and 15`, cooled, filtered and the volume was adjusted with demineralized water.

Samples collection:

Body weight of rats and food intake were recorded weekly. At the end of experiment, rats were anesthetized, blood samples were obtained from the orbital venous plexuses, collected for each group, dried to constant weight at 80°C and stored at 4°C until treatment. Liver and spleen were removed from each rat and rinsed with demineralized water, dried to a constant weight at 80°C weighed and frozen (Hamdaoui *et al.* 1997).

Analysis of samples:

Samples of dried blood, liver and spleen were ashed at 480°C in muffle furnace for 48 hrs., (Hamdaoui *et al.* 1997). Ash was weighed and dissolved in 25 ml 0.1 N HCl. Minerals content of Fe, Ca, P, Zn, Mg and Cu were determined by atomic absorption spectrophotometer (Perkin Elmer plasma 400) according to Issac and Kerber (1971).

RESULTS AND DISCUSSION

a- Body weight gain:

The body weights for control and tea groups before and after the experimental period are presented in table (1) and Figure (1). The mean body weight gain of groups received tea were ranged from 13.36 up to 35.18%, while the average of body weight gain percentage was 58.82% for control group. On the other hand, average weight gain for the animal group received tea with 50% milk was nearly the same as the control group (50.64%). The data in table (1) indicated Asao that tea decoction and infusion treatment for 21 days affected clearly on body weight especially in group received tea after 2 hrs of meal which gave the least percentage of body weight gain (13.36%) while addition of milk to tea (50%) gave the highest percentage of body weight gain (50.64%).

From the same table data indicated that every 100 gm of food intake gave the maximum benefit in the body weight (18.63 gm/100 gm) in group of tea + milk, while gave the minimum benefit in body weight (6.0 gm/100gm) in group of tea which gave after 2 hrs of meal compared with 15.15 gm/100 gm in control group.

Table (1):Effect of tea drink on body weight gain of rats.

	Mean of initial b.w. (gm)	Mean of final b.w. (gm)	Mean of body weight gain (gm)	Body weight gain %	Mean of food intake (gm)	gm b.w/ 100 gm food intake
Control group	68.00	108.00	40.00	58.82	264.00	15.15
Fine infusion tea	80.22	108.44	28.22	35.18	223.00	12.65
Fine decoction tea (5 min)	68.33	90.00	21.67	31.71	205.00	10.57
Fine decoction tea (15 min)	84.22	112.22	28.00	33.25	188.00	14.89
Fine decoction tea (15 min)2 hr after the meal	86.80	98.40	11.60	13.36	193.00	6.00
Coarse decoction tea (15 min.)	82.60	109.20	26.60	32.20	188.00	14.15
Fine decoction tea (15 min) + milk 50% v/v	69.90	105.30	35.40	50.64	190.00	18.63

b. Blood minerals:

Data in Table (2) indicates that tea drink infusion or decoction treatment for 21 days reduced the nonheme iron concentrations in blood of the animals groups consumed tea after meal. The iron content in the blood decreased from 35.79 $\mu\text{g}/1\text{ml}$ in control group to 13.39, 27.65 and 26.41 $\mu\text{g}/1\text{ml}$ in blood of rats received fine infusion tea, fine decoction tea (5 min.), and fine decoction tea (15 min) respectively. On the other hand, Fe increased in blood of rats received diet with decoction tea, 2 hrs after the meal group with increasing percentage 68.3% than the control.

In the same table, the level of zinc in the blood decreased from 1.07 $\mu\text{g/ml}$ in the control group to 0.26-0.71 $\mu\text{g/ml}$ in the tea groups, this decrease ranged from 33.6-73.5%. On the other hand; Ca content increased in all tea groups especially tea after 2 hrs of meal group. The increasing percentages of Ca in all groups were 2.97-96.78%. Mg and Cu in blood of tea groups have slight changed compared with control except for coarse decoction (15') which decreased from 15.62 and 1.5 $\mu\text{g/ml}$ in control group to 9.67 and 0.71 $\mu\text{g/ml}$ in coarse tea respectively.

Table (2): Effect of tea drink on different minerals concentrations in the blood ($\mu\text{g/ml}$) of different groups of rats.

Group	Fe	Zn	Mg	Ca	Cu	P
Control group	35.79	1.07	15.62	54.29	1.5	0.0
Fine infusion tea	13.39	0.30	18.66	60.57	1.47	0.0
Fine decoction tea (5 min)	27.65	0.71	-	-	1.69	0.0
Fine decoction tea (15 min)	26.41	0.28	18.31	72.18	1.19	0.0
Fine decoction tea (15 min) 2 hr after the meal	60.24	0.26	11.57	106.83	1.34	0.0
Coarse decoction tea (15 min.)	-	0.30	9.67	49.34	0.71	0.0
Fine decoction tea (15 min) + milk 50% v/v	25.86	0.43	12.6	55.90	1.38	0.0

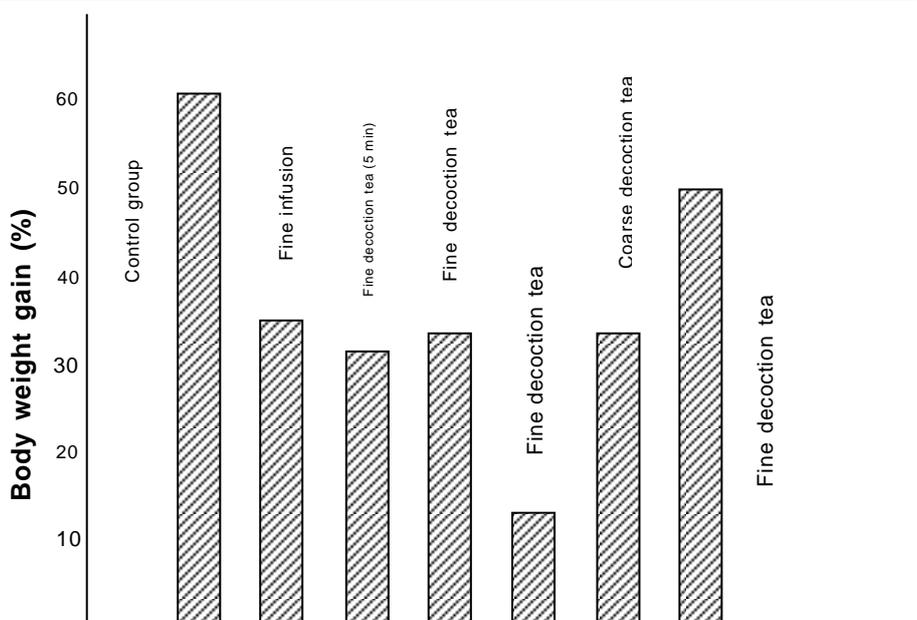


Fig. (1): Effect of tea drink on body weight gain of rats.

c- Storage minerals in liver and spleen:

Data in tables (3 and 4) we show that tea infusion tea and decoction tea (fine or coarse) decrease concentrations of all minerals under investigation. Fe for example, decreased in liver (table 3) of fine infusion tea, decoction tea (5'), decoction tea (15'), decoction tea (15') 2 hrs after meal, coarse decoction tea (15'), decoction tea (15') + 50% milk in percentages 48.33, 42.92, 58.85, 59.66, 44.53 and 59.1% respectively compared with Fe in control group liver. While Fe in spleen (table 4) decreased with percentages of 62.63, 35.0, 43.13, 26.22, 38.6 and 54% respectively compared with control group. The other minerals in liver and spleen decreased with approximately in similar manner.

Table (3): Effect of tea drink on minerals concentrations in the liver (µg/g dry weight of rat tissue).

Group	Fe	%of Fe decreasing	Zn	Mg	Ca	Cu	P
Control group	219.92	-	4.54	29.23	119.69	10.37	4.02
Fine infusion tea	113.62	48.33	2.89	11.80	86.72	19.97	0.4
Fine decoction tea (5 min)	125.52	42.92	3.17	16.27	90.07	6.19	0.1
Fine decoction tea (15 min)	90.50	58.85	2.59	10.72	56.13	3.60	0.65
Fine decoction tea (15 min) 2 hr after the meal	88.72	59.66	2.52	11.32	68.89	4.84	1.47
Coarse de coction tea (15 min.)	121.99	44.53	3.06	13.67	67.62	21.27	-
Fine decoction tea (15 min) + milk 50% v/v	89.95	59.10	2.48	23.49	91.09	5.59	2.09

Table (4): Effect of tea drink on different minerals concentrations in the spleen (ug/g dry weight of rat tissue).

Group	Fe	%of Fe decreasing	Zn	Mg	Ca	Cu	P
Control group	1100.84	-	9.88	222.54	479.12	53.18	35.0
Fine infusion tea	411.36	62.63	6.58	150.55	239.01	21.16	0.0
Fine decoction tea (5 min)	715.37	35.00	6.04	249.77	526.52	40.98	0.0
Fine decoction tea (15 min)	626.00	43.13	5.83	149.93	227.7	23.29	0.0
Fine decoction tea (15 min) 2 hr after the meal	812.15	26.22	5.29	169.22	288.48	25.96	0.0
Coarse decoction tea (15 min.)	675.89	38.60	6.67	130.44	223.39	14.56	0.0
Fine decoction tea (15 min) + milk 50% v/v	506.33	54.00	4.68	140.70	211.35	17.3	14.7

DISCUSSION

In this study, decoction and infusion tea prepared from fine or coarse powder of Lipton tea treatment for 21 days reduced the body weight of rats compared with control. These results are in harmony with Hamdaoui *et al.*, (1997) who found that decoction tea (50 gm/800 ml) for 15 days reduced the percentage of body weight gain from 13.2% for control group to 2.4% for tea group. They noted that the influence of decoction tea on body weight growth is non confirmed by other studies. However, Joslyn and Glick (1969) reported that feeding tannic acid (the main component of tea) to rats at 5 gm/100gm diet resulted in lower body weight gain (about 50% of control). Bressani *et al.*, (1983) reported that, high concentration of tannins reduced growth rate in rats. In contrast; Chang *et al.*, (1994) found that tannin isolated from tea in small concentration (0.0057, 0.0171 and 0.057 gm/100 gm diet) did not significantly change the body weight of rats. On the other hand, Bressani *et al.*, (1983) showed that the effect of decoction or infusion tea on body weight gain due to influence of tannin in tea on nitrogen and protein digestibility. Hamdaoui *et al.*, (1997) reported that decoction tea considered to be an important factor able to reduce body weight gain of rats. From the other side addition of milk to tea, kept the body weight to be the same like the control group. This result may be due to milk fat.

The present study indicates that tea drink decreased some elements in blood of rats especially nonheme iron, zinc and copper, increased calcium, increased magnesium in some treatments while decreased it in another. The results of reducing nonheme iron are in agreement with the previous study of Morck *et al.*, (1983) who reported that coffee and tea decreased the absorption of nonheme iron to 2.25 and 1.32% respectively.

Hamdaoui *et al.*, (1994) found that the inhibition of nonheme iron from Tunisian meal (couscous) varied from 36-61% with black tea and 30.5% with green tea (300, 200, 100 µg/ml). Also Hamdaoui *et al.*, (1995) showed that decoction tea (100 mg/ml) reduced nonheme iron absorption from couscous by 50%. Hamdaoui *et al.*, (1997) pointed out that, administrated ad libitum for 15 days reduced the nonheme iron in blood by 31.8% compared with control. Keen *et al.*, (1984) reported that the inhibitory effect of tea on nonheme iron may be due to forming an unabsorbable "iron-tannin" complex in the intestinal lumen of rats and this complex could also influence the absorption of other minerals such as Zn, Cu, Mg and Ca. On the other hand no one before explained why nonheme iron increased in the blood in group received tea after two hours of meal in the present study. Data of the present study also show that all minerals under investigation decreased in liver and spleen. These results are in contrast with the results of Hamdaoui *et al.*, (1997) who found that zinc, copper and magnesium increased in blood, liver and spleen with decoction tea compared with control. They also showed

that the mechanisms by which tea enhanced these metals still remain unknown.

CONCLUSION

This study showed that both decoction tea and infusion tea reduced significantly the body weight, while the addition of milk to tea kept the body weight gain like the control group. The results showed also that tea reduced significantly the nonheme iron, zinc and copper concentrations in the blood. On the other hand decoction tea which was received after two hours of the meal increased nonheme iron and calcium in the blood of rats. Fine decoction tea increased Mg and Ca in rats' blood. Tea, fine or coarse, infusion or decoction, with milk or without decreased the reserved Fe, Zn, Mg, Ca, Cu and P in both liver and spleen of rats.

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**تأثير مشروب الشاي على وزن الجسم ومدى الاستفادة الحيوية من بعض
العناصر المعدنية لفئران التجارب
وجيه أحمد المالكي و عبد المنعم عبد الغني سويلم
قسم الأغذية الطبية - الهيئة القومية للرقابة والبحوث الدوائية - القاهرة - مصر**

الهدف من هذا البحث هو دراسة تأثير الشاي الخشن أو الناعم في صورة شاي غير مغلي أو مغلي في الماء لمدد مختلفة ويعطى لفئران التجارب مباشرة بعد الوجبة أو بعد الوجبة بساعتين وذلك في صورة شاي سادة أو شاي مضاف إليه حليب (بنسبة ٥٠% ح/ح) وذلك على وزن الفئران ومدى الاستفادة من عناصر الحديد والكالسيوم والفوسفور والزنك والماغنسيوم والنحاس سواء في الدم أو المخزنة في الكبد والطحال . وقد أتضح من الدراسة أن تناول الشاي سواء المغلي أو الغير مغلي يؤدي إلى انقاص الزيادة في وزن الفئران بنسبة تتراوح ما بين ١٣,٣٦% إلى ٣٥,١٨% مقارنة بالعينة الضابطة ، أما بالنسبة للشاي المضاف إليه حليب (بنسبة ٥٠% بالحجم) فقد أعطى زيادة في وزن الفئران تقدره بـ ٥٠,٦٤% وهي تقارب الزيادة المتحصل عليها في العينة الضابطة التي وصلت فيها نسبة الزيادة في الوزن إلى ٥٨,٨٢% من الوزن الأصلي .

أشارت هذه الدراسة أيضا إلى أن الشاي المغلي أو المنقوع الذي يعطى بعد الأكل مباشرة يؤدي إلى خفض تركيز الحديد والزنك والنحاس سواء الموجود في الدم أو المخزن في الكبد الطحال بينما يؤدي الشاي الذي يعطى بعد الأكل بساعتين إلى زيادة الحديد والكالسيوم في الدم وانخفاضه في الكبد والطحال مقارنة بالعينة الضابطة.

من جهة أخرى يؤدي تناول الشاي بصفة عامة إلى زيادة الماغنسيوم والكالسيوم في الدم وانخفاض جميع العناصر تحت الدراسة المخزنة في كل من الكبد والطحال.