CHAPTER IV
RESULTS

This chapter of results composed of four major parts which were served to examine the antioxidant effects of vitamin C on endothelial function in non-diabetic and diabetic rats. These four major parts were listed in following :-

Protocol 1. The antioxidant effects of vitamin C supplementation on metabolic changes and hemodynamics changes

Metabolic changes

: blood glucose , plasma triglyceride , plasma cholesterol , and plasma vitamin C

: body weight

Hemodynamics changes

: mean arterial pressure

: arteriolar flow rate

Protocol 2. The antioxidant effect of vitamin C supplementation on leukocyte–endothelial interaction

Protocol 3. The antioxidant effect of vitamin C supplementation on responses of cerebral arteriole to endothelial –dependent and –independent vasodilators

Protocol 4. The antioxidant effect of vitamin C supplementation on ultrastructural changes of cerebral microvessels

I The antioxidant effect of vitamin C supplementation on metabolic changes and hemodynamics changes

1) Metabolic changes

The injection of streptozotocin 55 mg/kg/BW into 200-250 g Wistar Furth rats resulted in polydipsia, polyuria, polyphagia and hyperglycemia within 48 hours and showed persistent hyperglycemia through out the experiment. In the present study, the criteria used for diabetic rats was the blood glucose level that had to be higher than 300 mg/dl. Unsupplemented diabetic rats (STZ) exhibited hyperglycemia and loss of body weight compared to the non-diabetic control rats (CON). Vitamin C supplemented of diabetic rats (STZ-vit C) significantly decreased blood glucose and improved body weight only in 36 WKs;STZ-vit C rats (Table 1,2 and Fig 11,12)

Results of plasma vitamin C concentration studies in all control and diabetic rats with and without vitamin C supplementation are shown in Table 3 and Fig 13. The plasma level of vitamin C was reduced by 48.39%, 50.73% and 64.46% in 12, 24 and 36 WKs of STZ-rats compared to CON- rats respectively and normalized by vitamin C supplementation in all three monitored time points. In addition,there was a significant increase of plasma vitamin C level in CON-vit C rats.

The results shown in Table 4,5 and Fig 14,15 indicated that the triglycerides and cholesterol levels in STZ-rats were significant higher than CON-rats at the two monitored time points (24 and 36 WKs). Supplementation of vitamin C significantly decreased plasma triglycerides and cholesterol both in 24 and 36 WKs;STZ-vit C rats. However, there were no significant differences in these variables between CON and CON-vit C rats. Therefore, supplementation of non-diabetic rats with vitamin C did not significantly alter plasma concentrations of triglyceride and cholesterol.

2) Hemodynamics changes

Mean arterial pressure(MAP)and mean arteriolar flow rate(Q) were shown in Table 6-7 and Fig 18-19. The results indicated that MAP values of STZ-rats were significantly higher than those of controls in all three monitored time points. Vitamin C supplementation had effect to reduce the increased MAP in 24 and 36 WKs of STZ-vit C rats. As these results vitamin C supplementation were able to prevent hypertension in chronic hyperglycemic diabetic rats.

The arteriolar flow rate was evaluated from pial cerebral arteriolar diameter size between 20-30 μm by using $Q= V_m r^2 \pi$, where V_m(mean RBCvelocity).

Arteriolar flow rate of STZ-rats were significantly less than CON-rats for all three monitored time points (Table 7,Fig. 19). The vitamin C supplementation had effect to increase this arteriolar flow rate in STZ-vit C rats for all three monitored time points. In addition, there were no significant differences in MAP and arteriolar flow rate between CON and CON-vit C rats

II The antioxidant effects of vitamin C on leukocyte adhesion on endothelium of cerebral postcapillary venule

The leukocyte that was defined as the adherent cell to endothelium of poscapillary venule if that cell remained stationary for ≥ 30 seconds were counted. The adherent cells expressed as the number per 100 μm length of the postcapillary venule. Under normal conditions on resting period as shown in Table 8., the number of leukocyte adhesion were significantly higher in diabetic rats than in control rats with and without vitamin C supplementation (Table 8 and Fig 20-23). Vitamin C supplementation had effects to reduced the

number of leukocyte adhesion to endothelium of postcapillary venule in STZ-vit C rats, but can not normalized these adhesion to the control values.

III The antioxidant effects of vitamin C supplementation on responses of cerebral arterioles to endothelium- dependent and -independent vasodilators

1) Effect of vitamin C on vasodilation responses of cerebral arterioles to endothelium-dependent vasodilators

In the present study to examine the effect of vitamin C on responses of cerebral arterioles (20-30 μm) to endothelium dependent vasodilators, acetylcholine (Ach)10^{-7} M and adenosine 5' diphosphate (ADP)10^{-6} M were used to examine the endothelium function.

Ach produced dilatation of cerebral arterioles 63.87-70.66% from baseline in CON-rats with and without vitamin C supplementation but produced smaller dilatation of cerebral arterioles in STZ-rats than CON-rats in all monitored time points. (Table 9, Fig 24). Interestingly vasodilation responses were increased in diabetic rats supplemented with vitamin C. Therefore, it is indicated that the responses of cerebral arterioles to Ach are profoundly impaired in diabetic compared with non diabetic rats, and improved by vitamin C supplementation

ADP produced markedly dilatation of cerebral arterioles in CON-rats and CON-vit C rats but only small dilation of cerebral arterioles in STZ-rats (Table 10). The same as Ach , the vasodilation responses to ADP were improved by the supplementation of vitamin C for all three monitored time points. Therefore, the responses of cerebral arterioles to ADP are also

impaired in diabetic compared with non-diabetic and improved after vitamin C supplementation.

2) Effect of vitamin C on vasodilation response of cerebral arterioles to endothelium-independent vasodilator

When the endothelium-independent vasodilation responses to nitroglycerine (NTG)10^{-6} M were evaluated, no significant difference was found between control and diabetic rats both with and without vitamin C supplementation (Table 11).

IV The antioxidant effects of vitamin C supplementation on Ultratructural changes of Cerebral microvessels.

By using transmission electron microscopy, no ultrastructural changes of the endothelium in 12-, and 36- WKs of STZ-rats were observed. The tight junctions between the endothelium cells were intact. However, the ultrastructural were monitored and defined for their difference. The data regarding the thickness of the capillary (4-7 μm) basement membrane from 12 and 36 WKs of control and STZ rats with and without vitamin C supplementation were shown in Table 12-13. There were no ultrastructural changes in CON-vit C rats.Whereas, In STZ-rats, the basement membrane of both capillary and small arterioles were significantly thicker than in the controls for all three monitored time points(Figure 27-28, 29-30). Interestingly, vitamin C supplementation could prevent these diabetic ultrastructural changes. The findings of present study demonstrated that the ultrastructural changes of the cerebral microvascular basement membrane of

arterioles and capillaries of STZ-rats could be prevented by vitamin C supplementation.

Table 1. Means ± SEM of body weight (g) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Body Weight (g)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	490.27±11.66	472.16±5.03	282.00±14.14 **	278.83±15.87 ns , + +
24 weeks	536.11±6.27	527.28±12.73	300.18±9.84 **	327.83±19.38 ns, + +
36 weeks	567.14±10.16	595.00± 3.27	269.50±11.57 **	330.50±21.32 #, + +

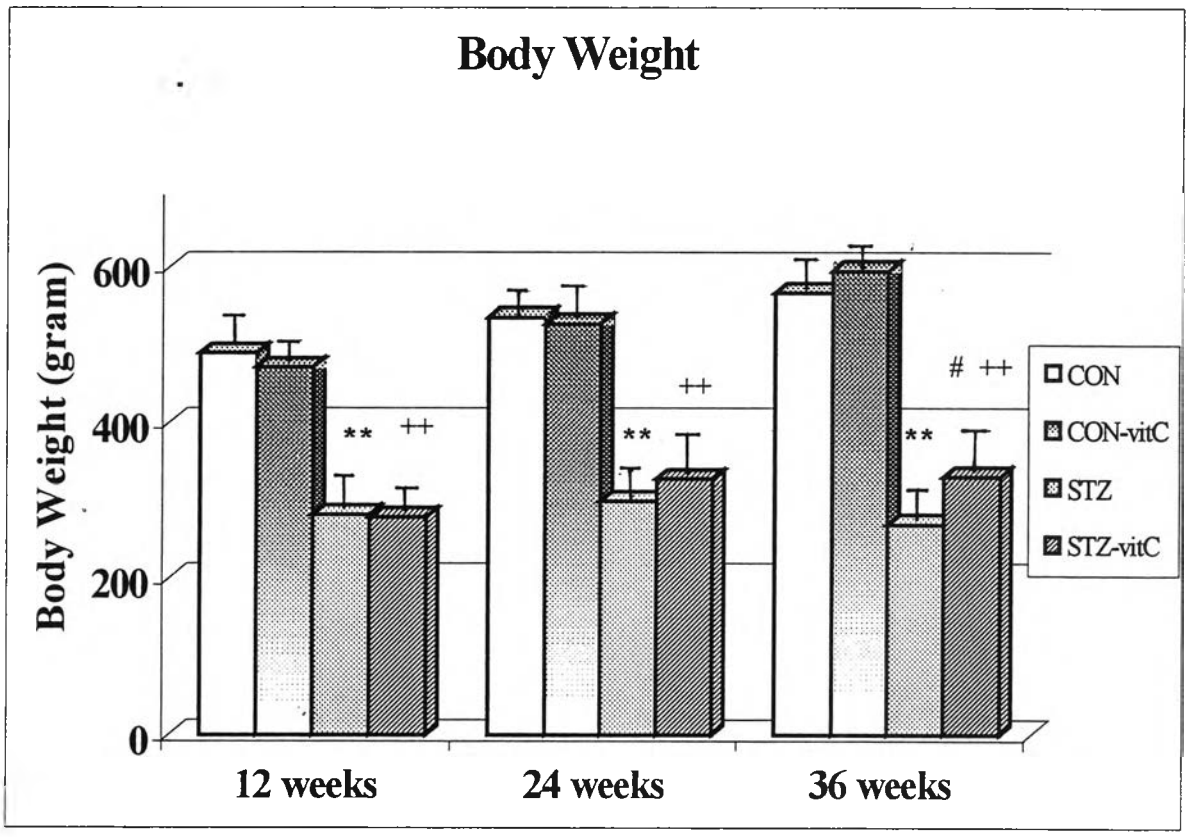
** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.05$)

+ + Significantly different as compared to CON ($P < 0.01$)

ns: no significant difference as compared to STZ

Figure 13. Effect of vitamin C supplementation on the body weight



Values: mean ±SEM

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC; streptozotocin-induced diabetic rats supplementation with vitamin C

** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.05$)

+ + Significantly different as compared to CON ($P < 0.01$)

Table 2. Means ± SEM of blood glucose (mg/dl) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Blood Glucose (mg/dl)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	99.00±1.57	99.00±1.48	407.00±35.48**	381.16±15.80 ns, ++
24 weeks	103.42±2.08	100.85±1.24	397.09±20.83**	359.80±23.37 ns, ++
36 weeks	99.73±1.82	101.00±1.77	398.12±17.12**	317.28±29.58 #, ++

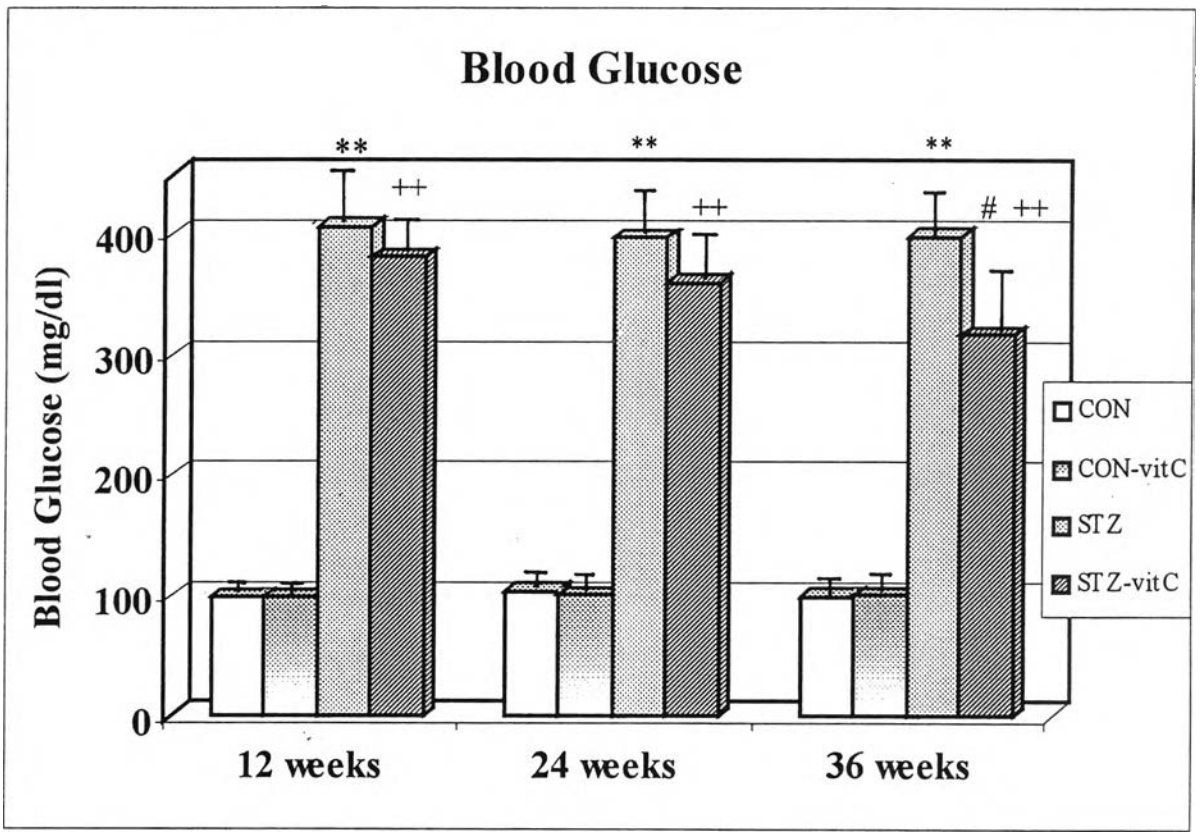
** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.05$)

++ Significantly different as compared to CON ($P < 0.01$)

ns: no significant difference compared with STZ

Figure 14. Effect of vitamin C supplementation on blood glucose



Values: mean ±SEM

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC; streptozotocin-induced diabetic rats supplementation with vitamin C

** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.05$)

+ + Significantly different as compared to CON ($P < 0.01$)

Table 3. Means ± SEM of plasma vitamin C(μmol/L) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

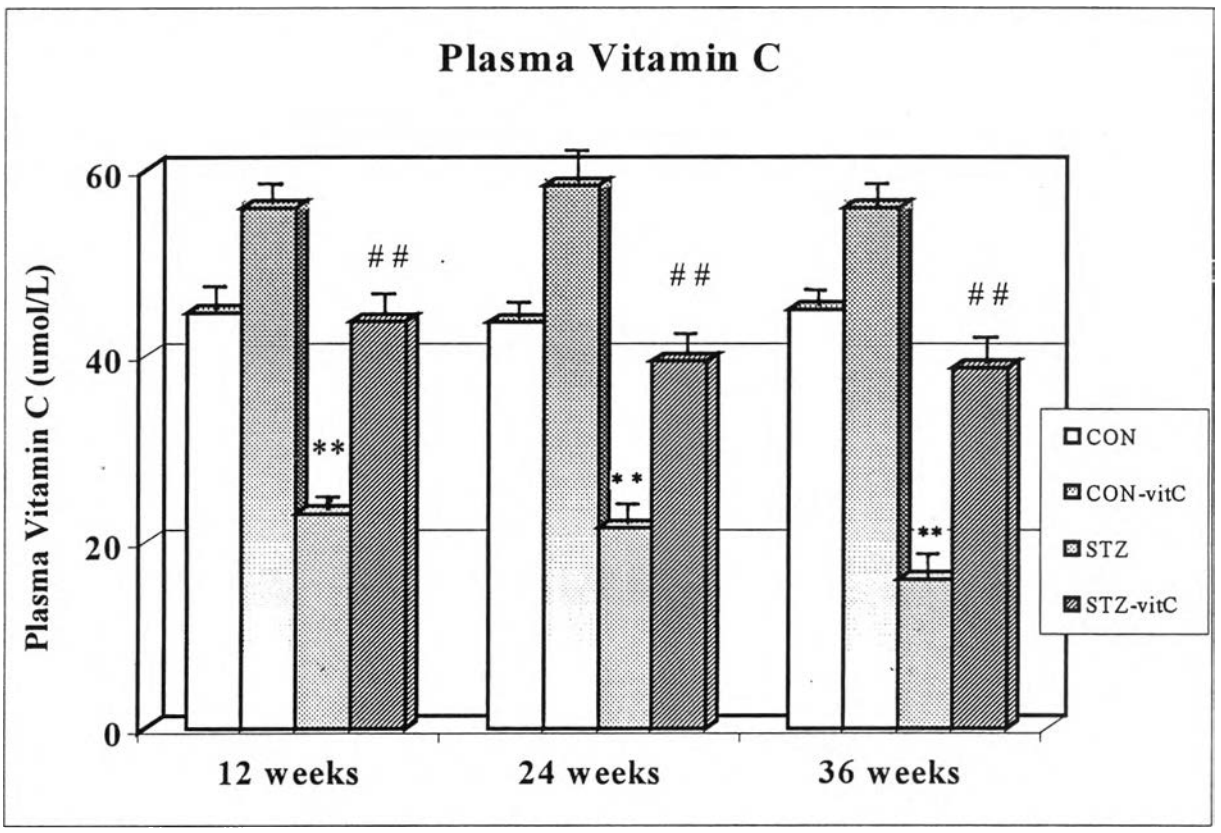
Duration	Plasma vitamin C (μmol/L)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	44.59±2.12	55.93±2.09	23.01±0.92**	43.66±3.92## , Ns
24 weeks	43.58±1.19	58.33±4.47	21.47±1.87**	39.44±2.04## , Ns
36 weeks	44.89±2.93	55.91±3.60	15.95±2.02**	38.65±2.02## , Ns

** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.01$)

Ns: no significant difference compared with CON

Figure 15. Effect of vitamin C supplementation on plasma vitamin C.



Values: mean ±SEM

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC; streptozotocin-induced diabetic rats supplementation with vitamin C

** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.01$) **

Table4. Means ± SEM of plasma cholesterol (mg/dl) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitaminC (STZ-vit C)

Duration	Plasma Cholesterol (mg/dl)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	74.29±6.31	75.86±11.61	NS 71.86±8.52	ns, Ns 72.67±6.51
24 weeks	• 66.83±3.11	75.50±8.86	* 95.80±9.31	# #, Ns 63.00±3.72
36 weeks	71.20±6.03	81.00±6.89	** 157.83±25.21	# #, Ns 71.33±4.72

* Significantly different as compared to CON ($p < 0.05$)

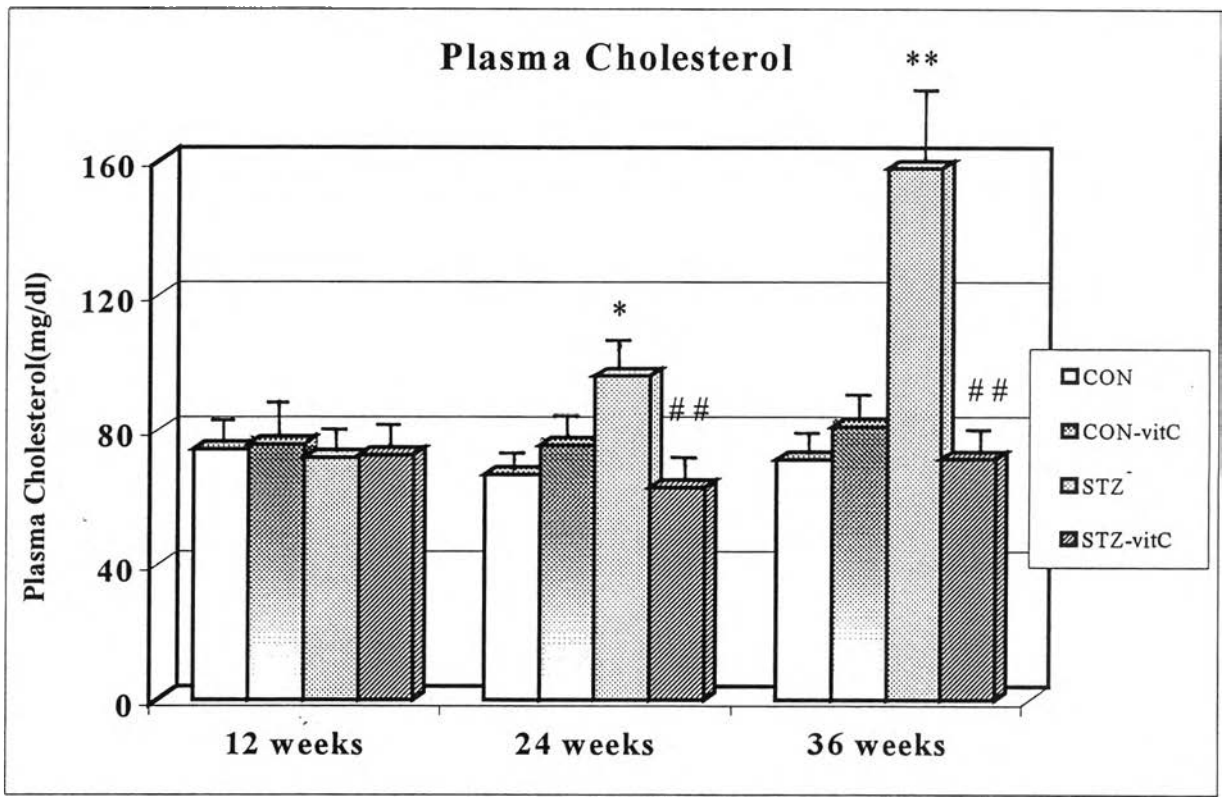
** Significantly different as compared to CON ($p < 0.01$)

\#\# Significantly different as compared to STZ ($p < 0.01$)

NS, Ns: no significant difference as compared to CON

ns: no significant difference as compared to STZ

Figure 16. Effect of vitamin C supplementation on plasma cholesterol.



Values: mean ±SEM

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC; streptozotocin-induced diabetic rats supplementation with vitamin C

* Significantly different as compared to CON ($p < 0.05$)

** Significantly different as compared to CON ($p < 0.01$)

\#\# Significantly different as compared to STZ ($p < 0.01$)

Table 5. Means ± SEM of plasma triglyceride(mg/dl) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Plasma Triglyceride (mg/dl)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	85.00±19.63	47.29±14.48	NS 94.29±21.16	ns, Ns 50.50±6.15
24 weeks	66.00±6.30	78.25±11.12	* 144.80±78.46	#, Ns 71.00±15.47
36 weeks	79.80±14.18	86.00±22.66	** 154.17±37.09	# #, Ns 53.56±8.13

* Significantly different as compared to CON ($p < 0.05$)

** Significantly different as compared to CON ($p < 0.05$)

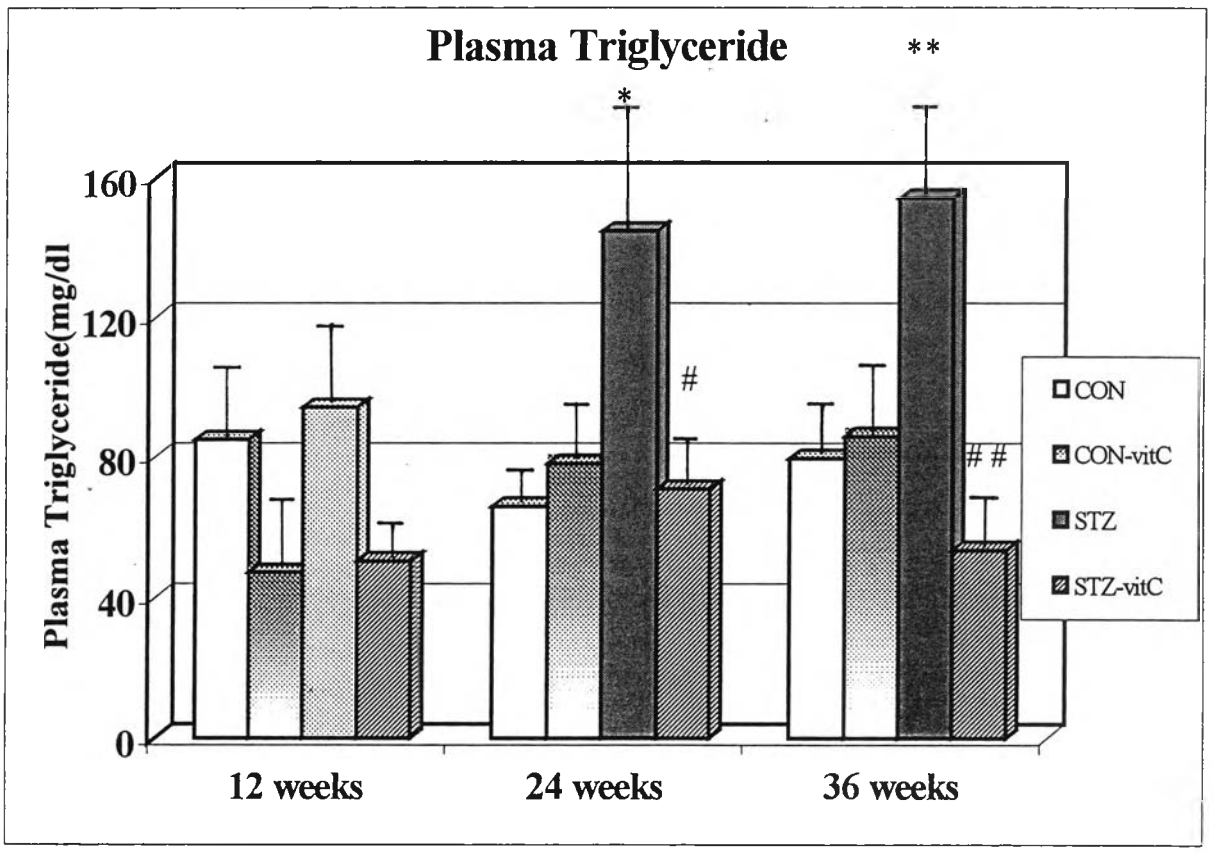
\# Significantly different as compared to STZ ($p < 0.05$)

\#\# Significantly different as compared to STZ ($p < 0.01$)

NS, Ns: no significant difference as compared to CON

ns: no significant difference as compared to STZ

Figure 17. Effect of vitamin C supplementation on plasma Triglyceride.



Values: mean ±SEM

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC; streptozotocin-induced diabetic rats supplementation with vitamin C

* Significantly different as compared to CON ($p < 0.05$)

** Significantly different as compared to CON ($p < 0.05$)

\# Significantly different as compared to STZ ($p < 0.05$)

\#\# Significantly different as compared to STZ ($p < 0.01$)

Table 6. Means ± SEM of mean arterial pressure (mmHg) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Mean Arterial Pressure (mmHg)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	93.39±3.99	97.95±3.34	128.288±2.64 **	103.74±7.85 ##, Ns
24 weeks	97.00±2.58	96.98±1.93	128.41±6.31 *	110.82±1.31 ##, Ns
36 weeks	98.41±1.27	95.67±3.39	125.72±3.21 **	111.00±3.09 ##, + +

* Significantly different as compared to CON ($P < 0.05$)

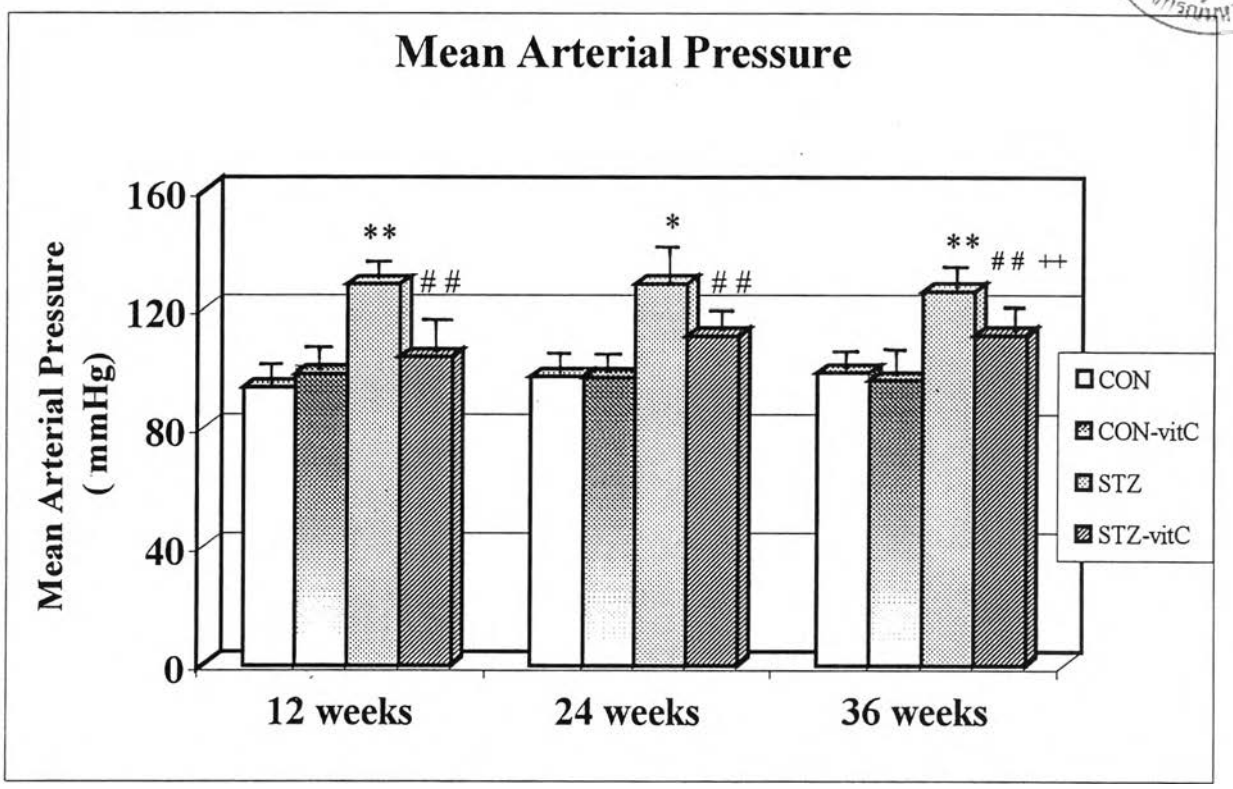
** Significantly different as compared to CON ($P < 0.01$)

Significantly different as compared to STZ ($P < 0.01$)

+ + Significantly different as compared to CON ($P < 0.01$)

Ns : no significant difference as compared to CON

Figure 18. Effect of vitamin C supplementation on mean arterial pressure



Values: mean ±SEM

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC; streptozotocin-induced diabetic rats supplementation with vitamin C

* Significantly different as compared to CON ($P < 0.05$)

** Significantly different as compared to CON ($P < 0.01$)

\#\# Significantly different as compared to STZ ($P < 0.01$)

+ + Significantly different as compared to CON ($P < 0.01$)

Table 7. Means ± SEM of arteriolar flow rate (nl/sec) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Arteriolar Flow Rate (nl/sec)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	1.03±0.14	1.13±0.10	NS 1.14±0.10	ns, Ns 1.17±0.14
24 weeks	1.13±0.09	1.31±0.16	NS 0.88±0.10	ns, Ns 1.12±0.13
36 weeks	1.99±0.10	1.12±0.12	** 0.40±0.04	##, Ns 1.92±0.09

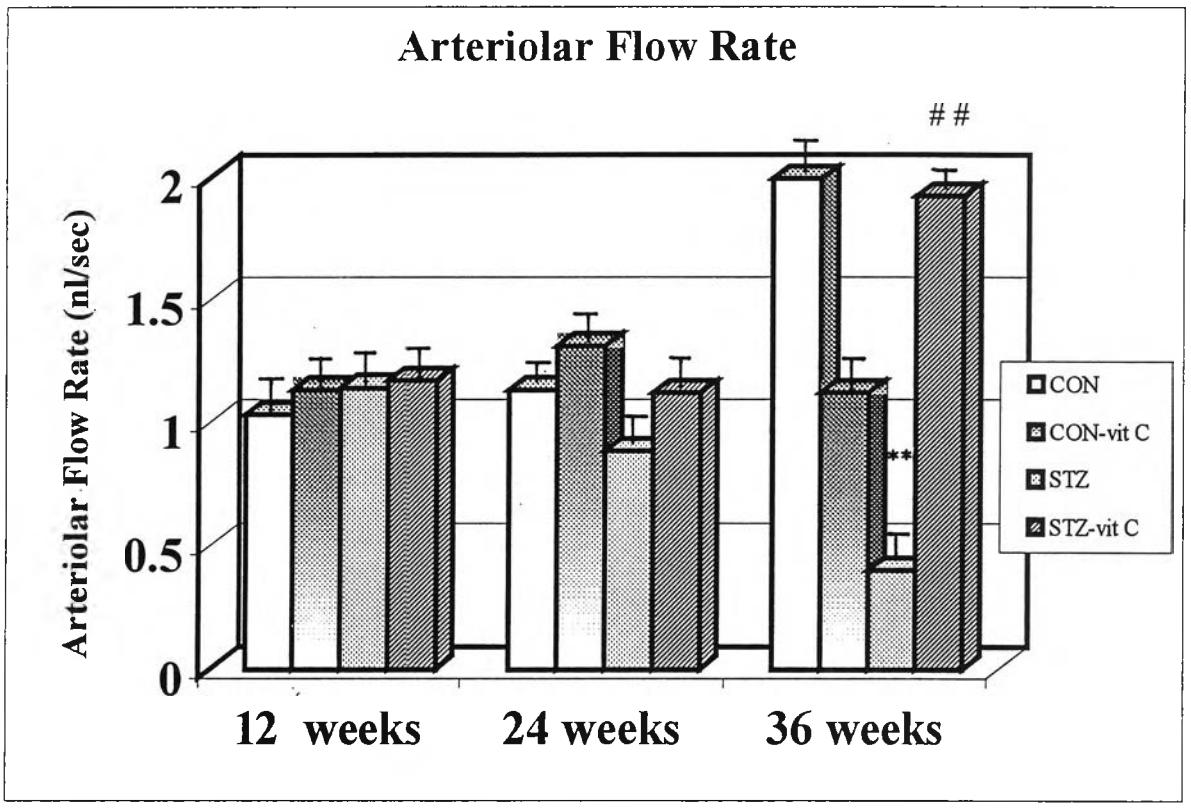
** Significantly different as compared to CON ($P < 0.01$)

Significantly different as compared to STZ ($P < 0.01$)

NS, Ns : no significant difference as compared to CON

ns : no significant difference as compared to STZ

Figure 19. Effect of vitamin C supplementation on arteriolar flow rate



Values: mean ± SEM

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ–vit C ; streptozotocin-induced diabetic rats supplementation with vitamin C

** Significantly different as compared to CON ($P < 0.01$)

Significantly different as compared to STZ ($P < 0.01$)

Table 8. Means ± SEM of number of leukocytes adhesion (cells/100μm) from postcapillary venules of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Leukocytes Adhesion (cells/100 μm)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	0.42±0.22	0.66±0.22	3.77±0.29 **	1.18±0.36 ##, Ns
24 weeks	0.71±0.23	0.80±0.18	3.74±0.28 **	0.468±0.21 ##, Ns
36 weeks	0.62±0.16	0.50±0.15	4.63±0.33 **	0.19±0.18 ##, ++

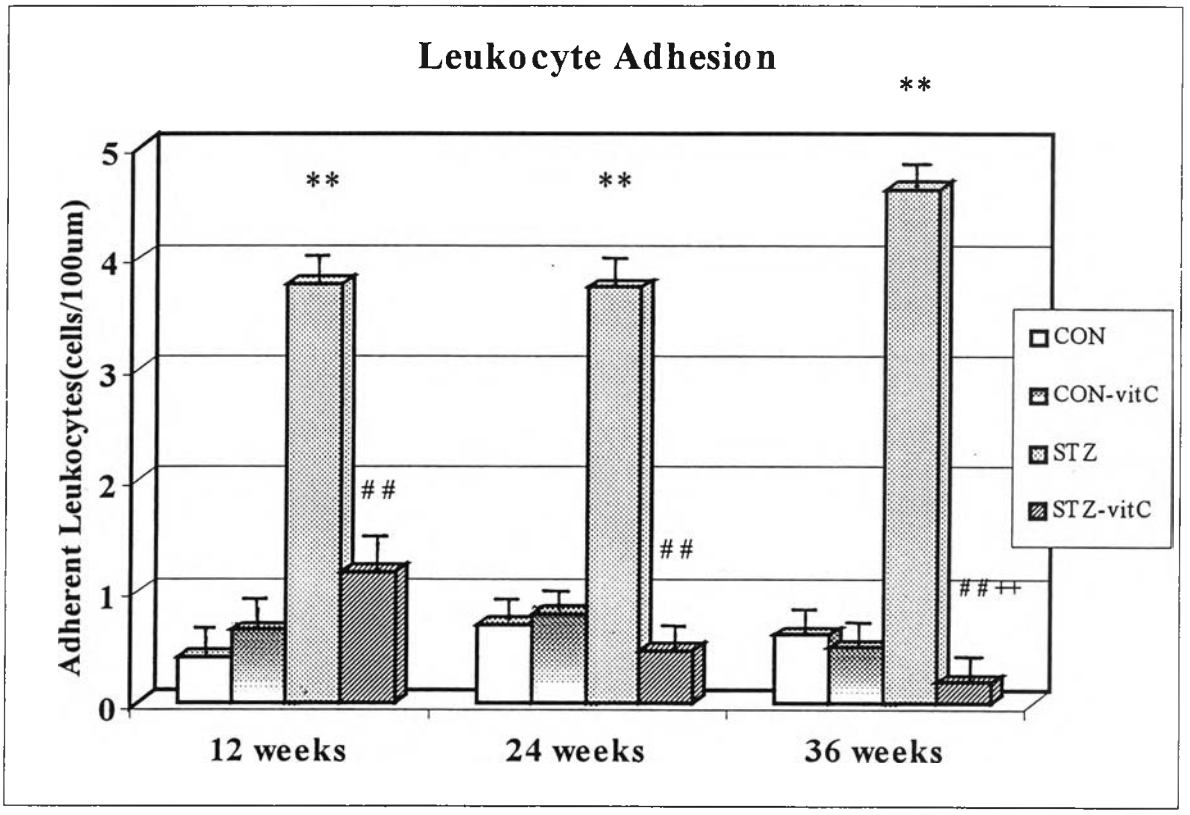
** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.01$)

++Significantly different as compared to CON ($p < 0.01$)

Ns: no significant difference as compared to CON

Figure 20. Effect of vitamin C supplementation on leukocyte adhesion.



Values: mean ±SEM.

CON ; non-diabetic control rats

CON– vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ–vit C ; streptozotocin-induced diabetic rats supplementation with vitamin C

** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.01$)

++Significantly different as compared to CON ($p < 0.01$)

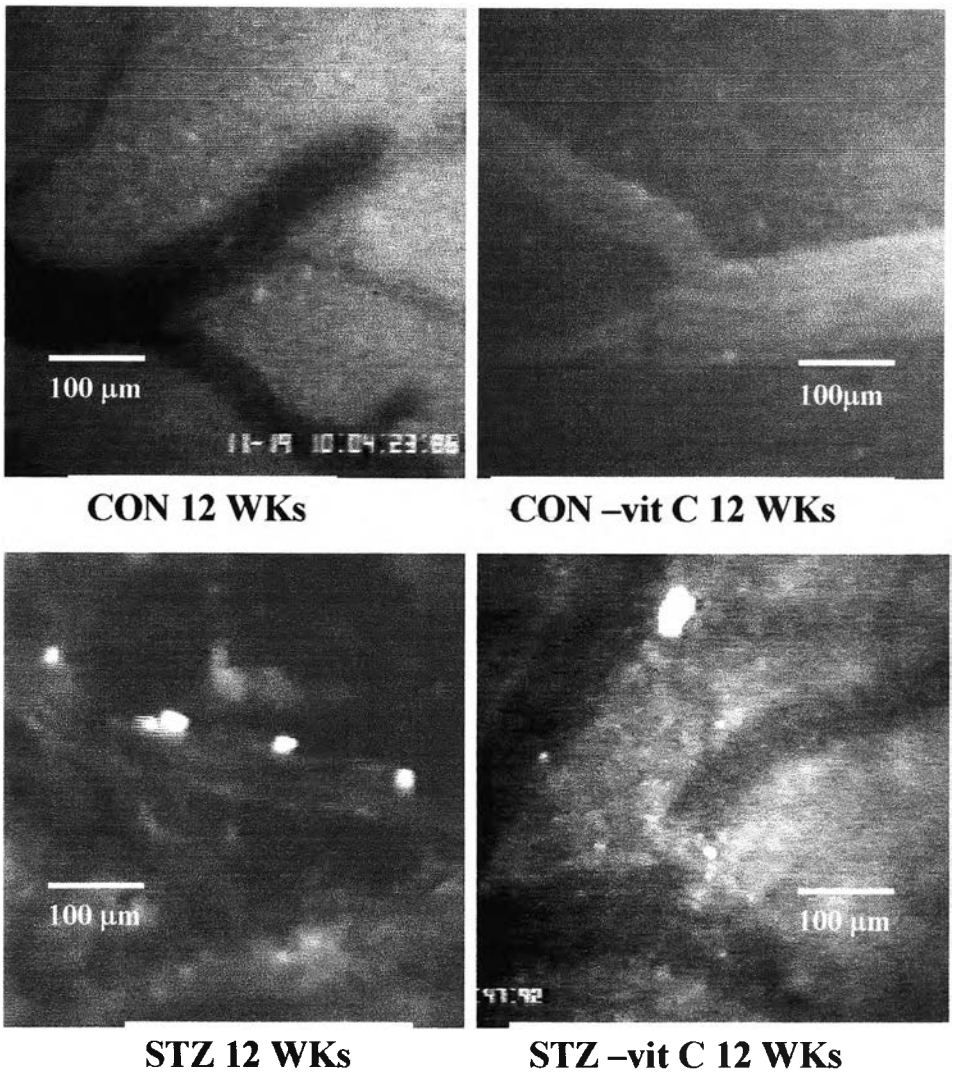


Figure 21. Intravital microscopic demonstration of leukocyte adhesion in the postcapillary venule of 12 WKs control and STZ rats with and without vitamin C supplementation. White dots represent leukocytes stained by intravenous injection of the fluorescent marker, Rhodamine 6 G

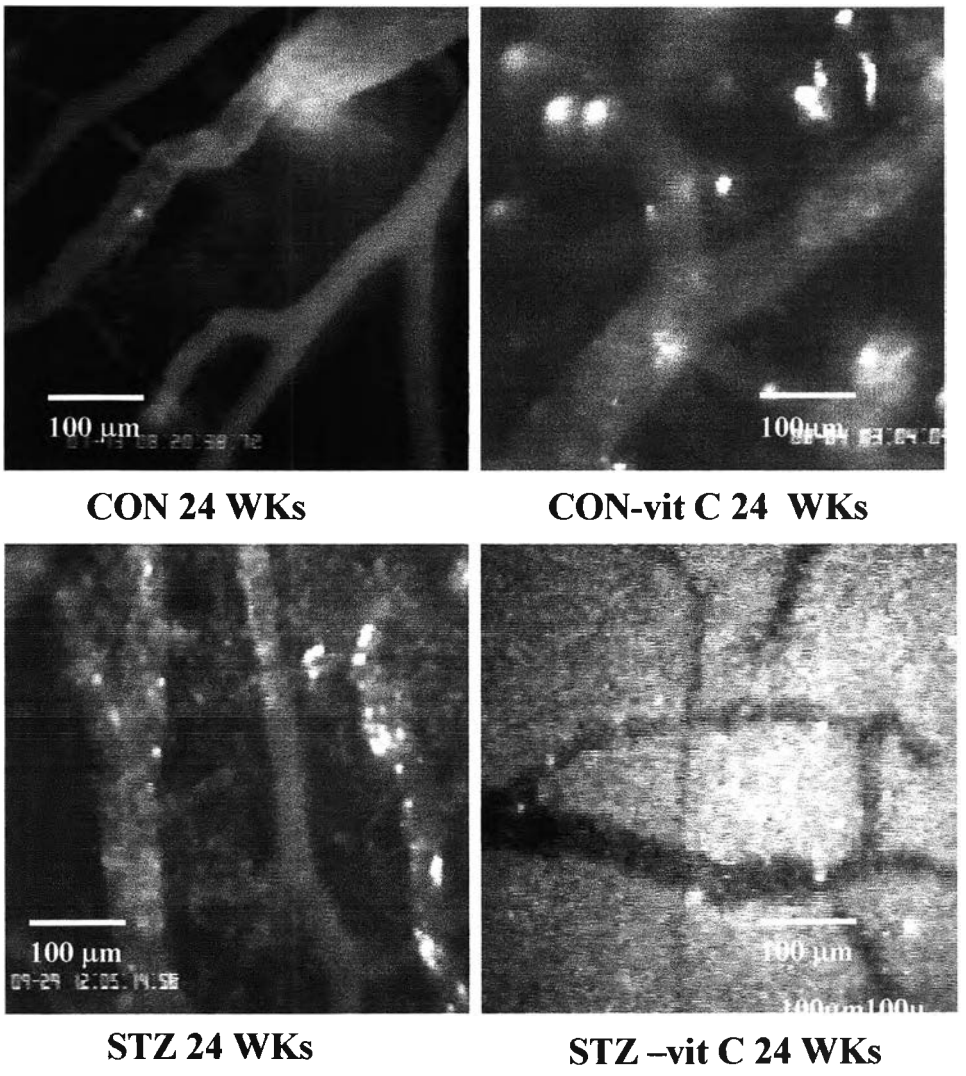


Figure 22. Intravital microscopic demonstration of leukocyte adhesion in the postcapillary venule of 24 WKs control and STZ rats with and without vitamin C supplementation. White dots represent leukocytes stained by intravenous injection of the fluorescent marker, Rhodamine 6 G.

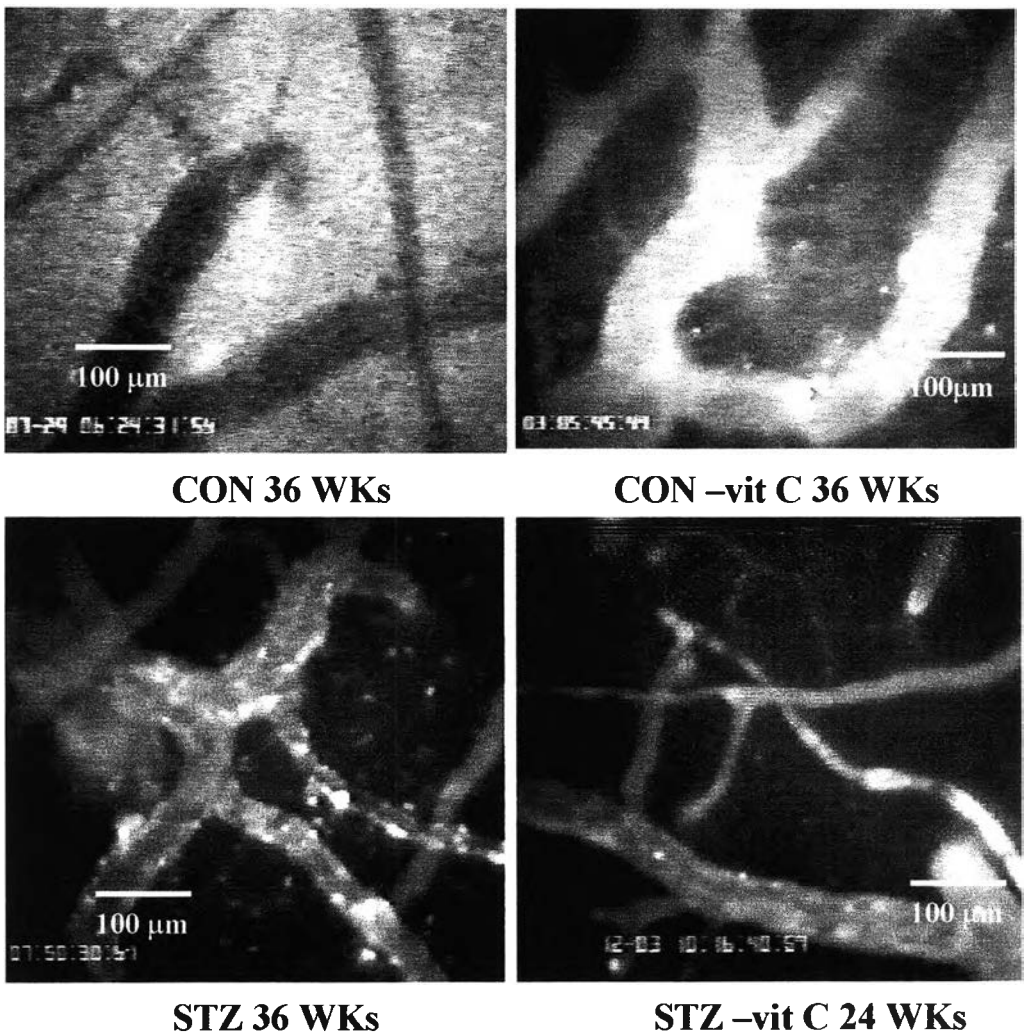


Figure 23. Intravital microscopic demonstration of leukocyte adhesion in the postcapillary venule of 36 WKs control and STZ rats with and without vitamin C supplementation. White dots represent leukocytes stained by intravenous injection of the fluorescent marker, Rhodamine 6 G.

Table 9. Means ± SEM of responses of cerebral arteriole (20-30 μm) to acetylcholine of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Vasodilation(% changes from baseline)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	69.82±1.96	70.66±4.50	43.49±5.64 **	60.35±2.63 #, +
24 weeks	67.35±5.87	63.87±4.80	36.92±4.36 **	51.06±5.50 ns, Ns
36 weeks	63.68±14.47	68.69±16.01	34.63±2.81 **	58.71±2.93 ##, Ns

** Significantly different as compared to CON ($p < 0.01$).

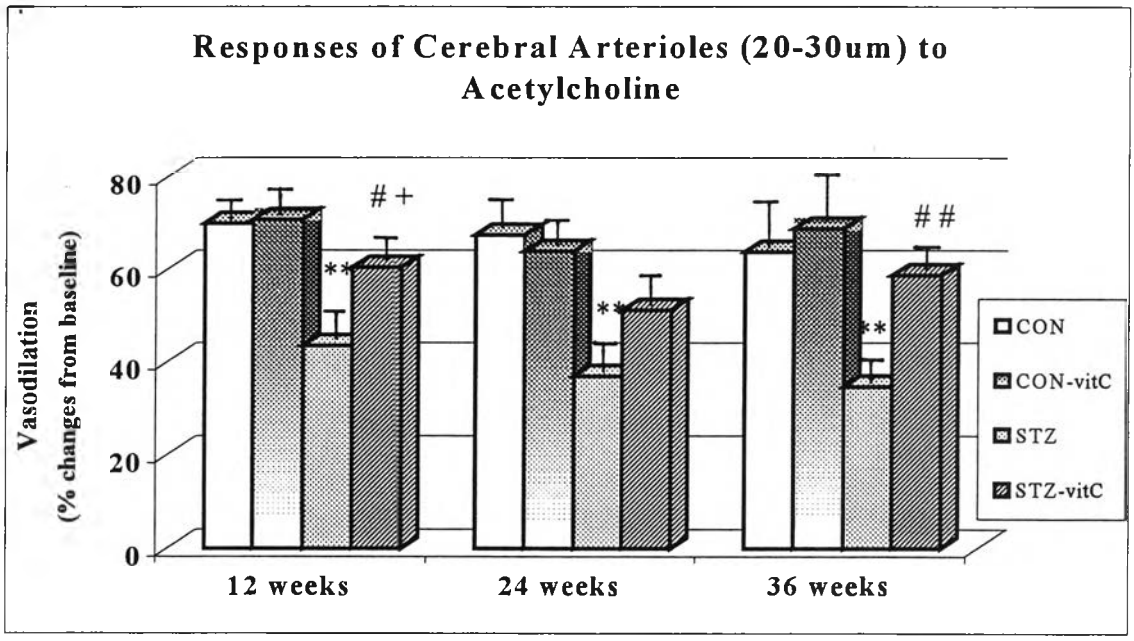
Significantly different as compared to STZ ($p < 0.05$).

Significantly different as compared to STZ ($p < 0.01$).

ns: no significant difference as compared to STZ

Ns: no significant difference as ccmpared to CON

Figure 24. Effect of vitamin C supplementation on responses of cerebral arterioles (20-30 μm) to acetylcholine.



Values: mean ±SEM.

CON ; non-diabetic control rats

CON– vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ–vit C ; streptozotocin-induced diabetic rats supplementation with vitamin C

** Significantly different as compared to CON ($p < 0.01$).

Significantly different as compared to STZ ($p < 0.05$).

Significantly different as compared to STZ ($p < 0.01$).

Table10. Means ± SEM of responses of cerebral arteriole (20-30 μm) to adenosine-5' diphosphate of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Vasodilation(% changes from baseline)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	64.79±8.92	67.28±3.09	41.65±3.34 *	48.19±5.16 ns, Ns
24 weeks	72.58±4.31	68.32±6.9	31.61±2.94 **	49.54±5.70 #, ++
36 weeks	63.34±4.16	78.57±4.66	30.45±3.61 **	53.33±4.10 ##, Ns

* Significantly different as compared to CON ($p < 0.05$)

** Significantly different as compared to CON ($p < 0.01$)

\# Significantly different as compared to STZ ($p < 0.05$)

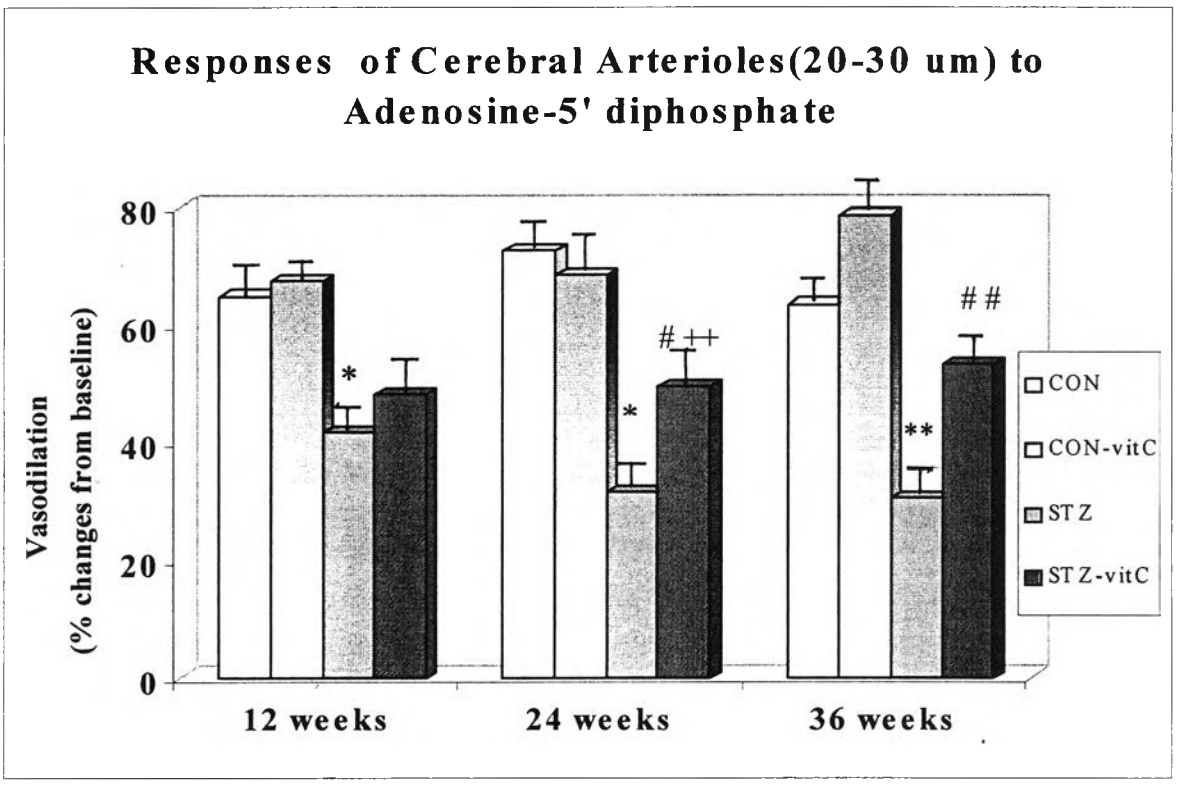
\#\# Significantly different as compared to STZ ($p < 0.01$)

+ + Significantly different as compared to CON ($p < 0.01$)

ns: no significant difference as compared to STZ

Ns: no significant difference as compared to CON

Figure 25. Effect of vitamin C supplementation on responses of cerebral arterioles (20-30 μm) to adenosine-5' diphosphate.



Values: mean ±SEM.

CON ; non-diabetic control rats

CON– vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ–vit C ; streptozotocin-induced diabetic rats supplementation with vitamin C

* Significantly different as compared to CON ($p < 0.05$)

** Significantly different as compared to CON ($p < 0.01$)

\# Significantly different as compared to STZ ($p < 0.05$)

\#\# Significantly different as compared to STZ ($p < 0.01$)

+ + Significantly different as compared to CON ($p < 0.01$)

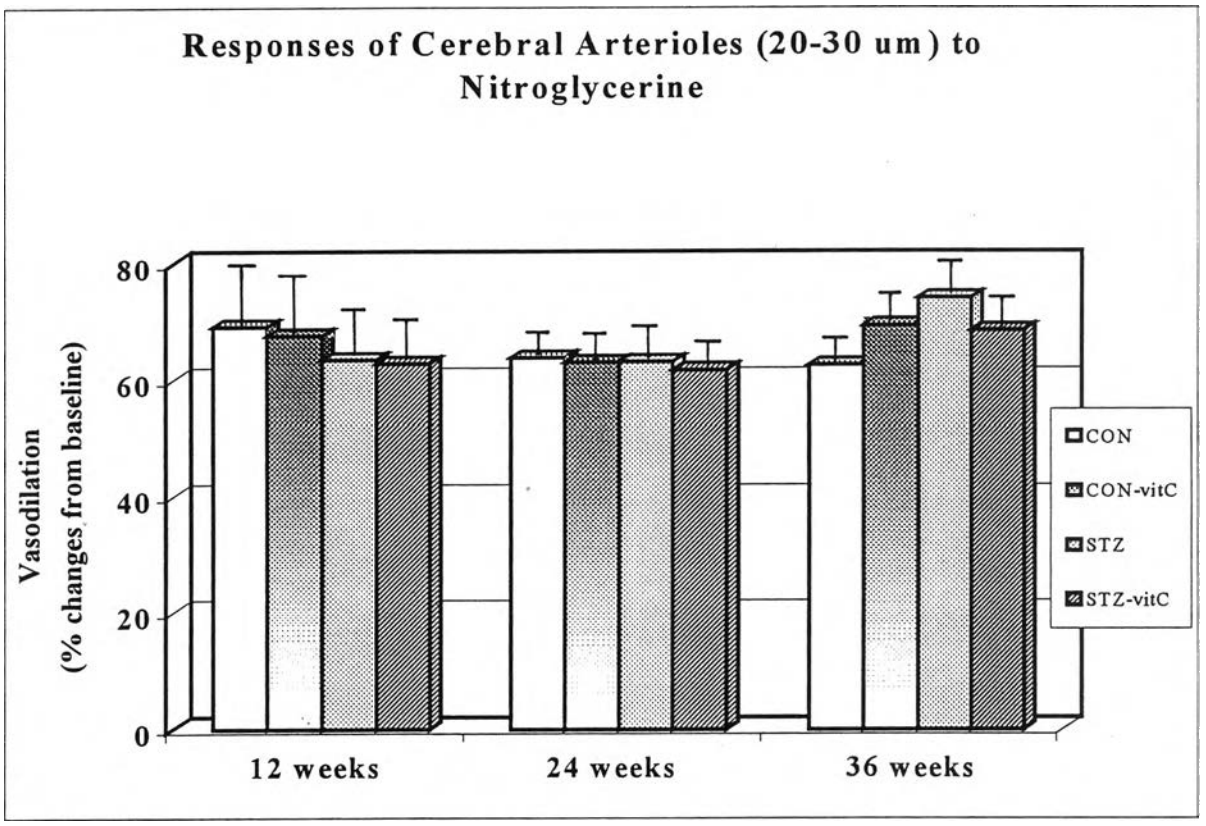
Table 11. Means ± SEM of responses of cerebral arteriole(20-30 μm) to nitroglycerine of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Vasodilation(% changes from baseline)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	69.13±23.53	67.53±23.58	NS 63.38±14.82	ns, Ns 62.76±10.69
24 weeks	63.67±3.23	63.00±2.66	NS 63.04±4.06	ns, Ns 61.67±3.19
36 weeks	62.52±4.49	69.29±4.20	NS 74.02±6.72	ns,Ns 68.38 ±5.91

NS, Ns: no significant difference as compared to CON

ns: no significant difference as compared to STZ

Figure 26. Effect of vitamin C supplementation on responses of cerebral arterioles (20-30 μm) to nitroglycerine.



Values: mean ±SEM.

CON ; non-diabetic control rats

CON– vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ–vit C ; streptozotocin-induced diabetic rats supplementation with vitamin C

Table12. Means ± SEM of basement membrane thickening from small arteriole (10-20μm) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Basement Membrane Thickening(μm)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	0.079±0.008	0.093±0.005	0.216±0.010 **	0.104±0.005 ##, +
36 weeks	0.123±0.005	0.128±0.008	0.231±0.018 **	0.132±0.007 ##, Ns

Values: mean ±SEM.

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC ; streptozotocin-induced diabetic rats supplementation with vitamin C

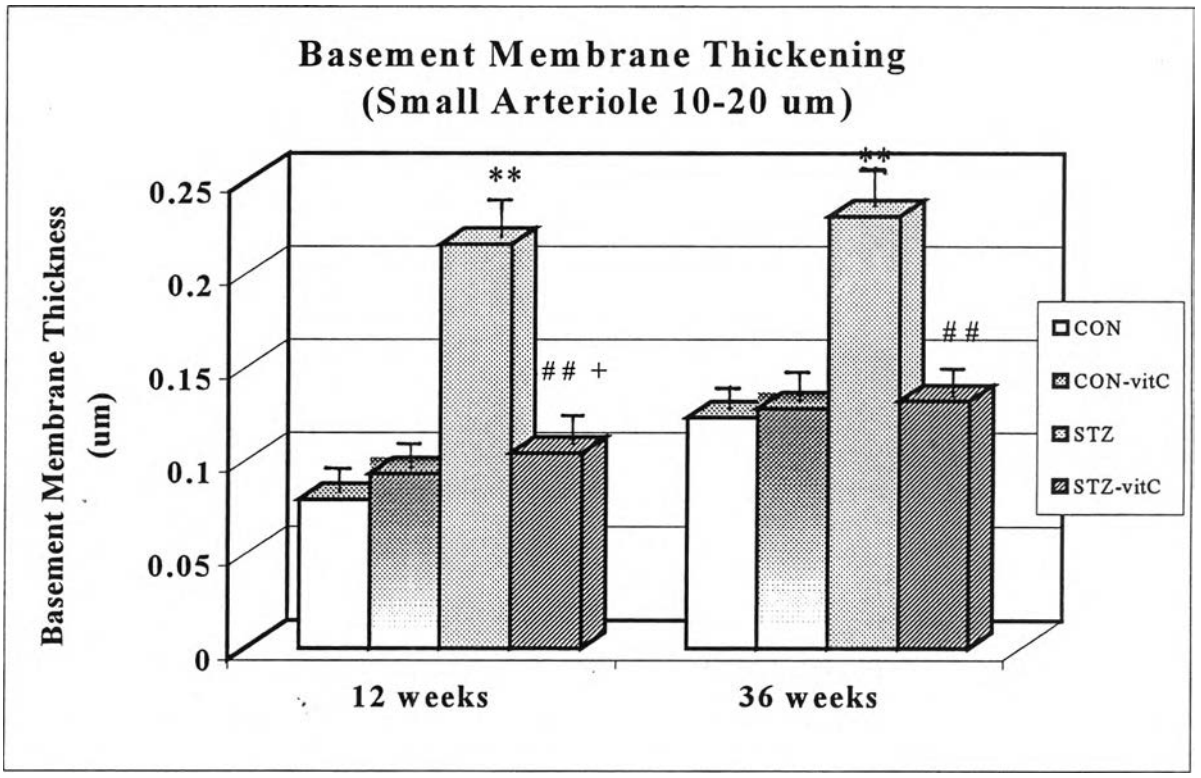
** Significantly different as compared to CON ($p< 0.01$)

Significantly different as compared to STZ ($p< 0.01$)

+ Significantly different as compared to CON ($p< 0.05$)

Ns: no significant difference as compared to CON

Figure 27. Effect of vitamin C supplementation on basement membrane thickening of small arteriole (10-20 μm).



Values: mean ±SEM.

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC ; streptozotocin-induced diabetic rats supplementation with vitamin C

** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.01$)

+ Significantly different as compared to CON ($p < 0.05$)

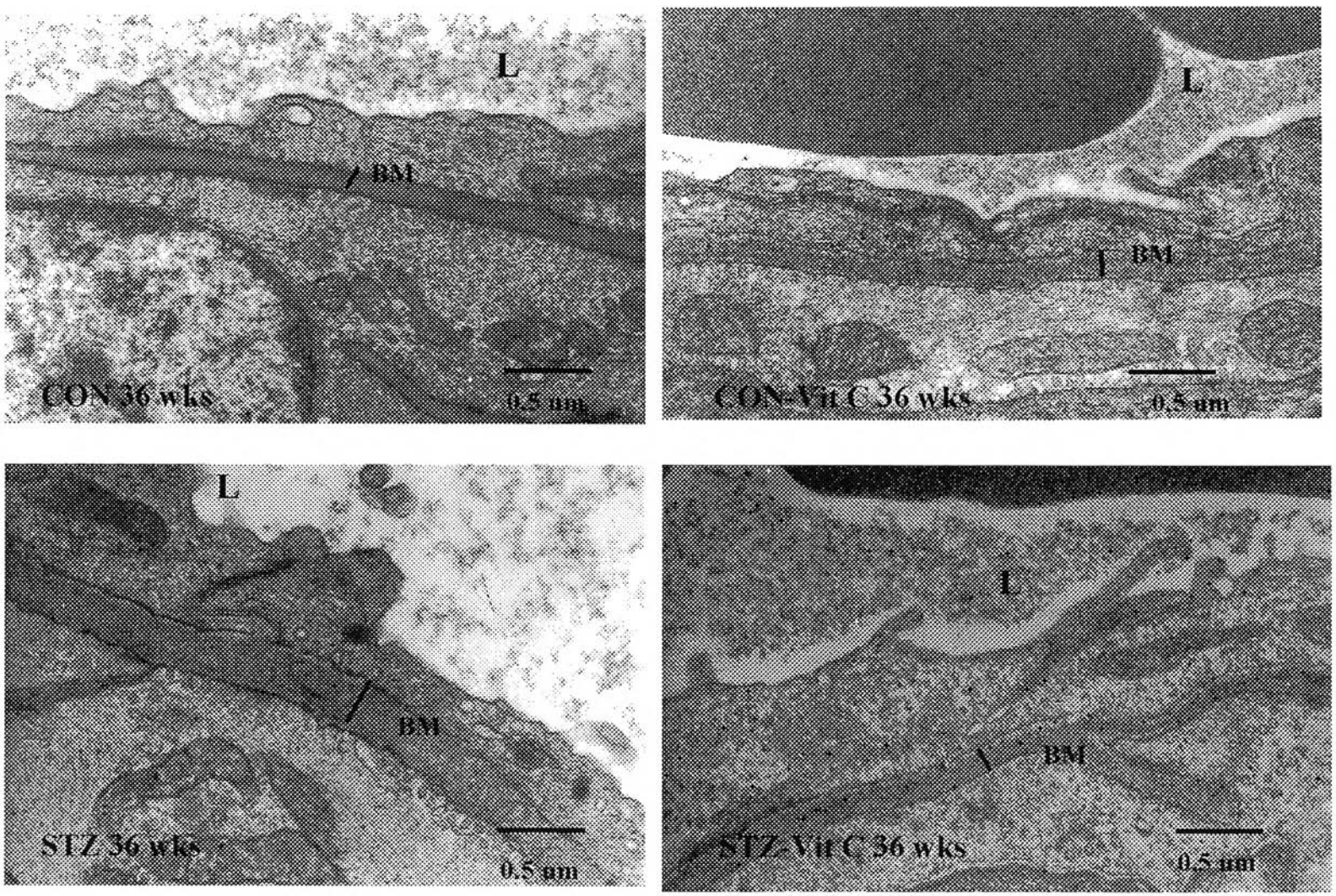


Figure 28 TEM photomicrograph of cerebral small arterioles(10-20um) from 36 wks of control and STZ-rats with and without vitamin C supplementation.Note greatly widened basement membrane (BM). L: arteriolar lumen.

Table13. Means ± SEM of basement membrane thickening from capillary (4 -7μm) of control rats (CON), control rats supplementation with vitamin C (CON-vit C), streptozotocin rats (STZ) and streptozotocin rats supplementation with vitamin C (STZ-vit C)

Duration	Basement Membrane Thickening(μm)			
	CON	CON- vit C	STZ	STZ-vit C
12 weeks	0.058±0.003	0.063±0.027	0.133±0.062 **	0.079±0.003 ##, + +
36 weeks	0.073±0.004	0.092±0.045	0.161±0.01 **	0.068±0.005 ##, Ns

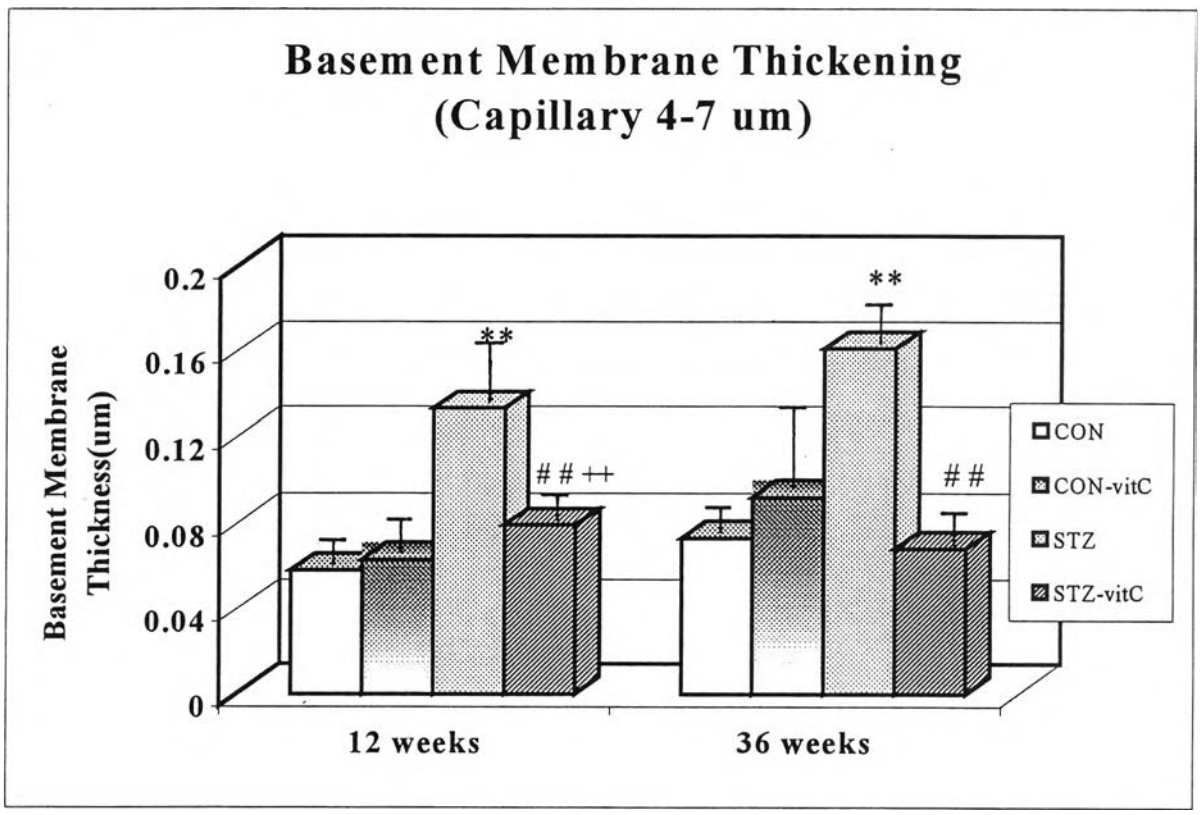
** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.01$)

+ + Significantly different as compared to CON ($p < 0.01$)

Ns : no significant difference as compared to CON

Figure 29. Effect of vitamin C supplementation on basement membrane thickening of capillary (4-7 μm).



Values are mean ±SEM.

CON ; non-diabetic control rats

CON –vit C; non-diabetic control rats supplementation with vitamin C

STZ ; streptozotocin-induced diabetic rats

STZ-vitC ; streptozotocin-induced diabetic rats supplementation with vitamin C

** Significantly different as compared to CON ($p < 0.01$)

Significantly different as compared to STZ ($p < 0.01$)

+ + Significantly different as compared to CON ($p < 0.01$)

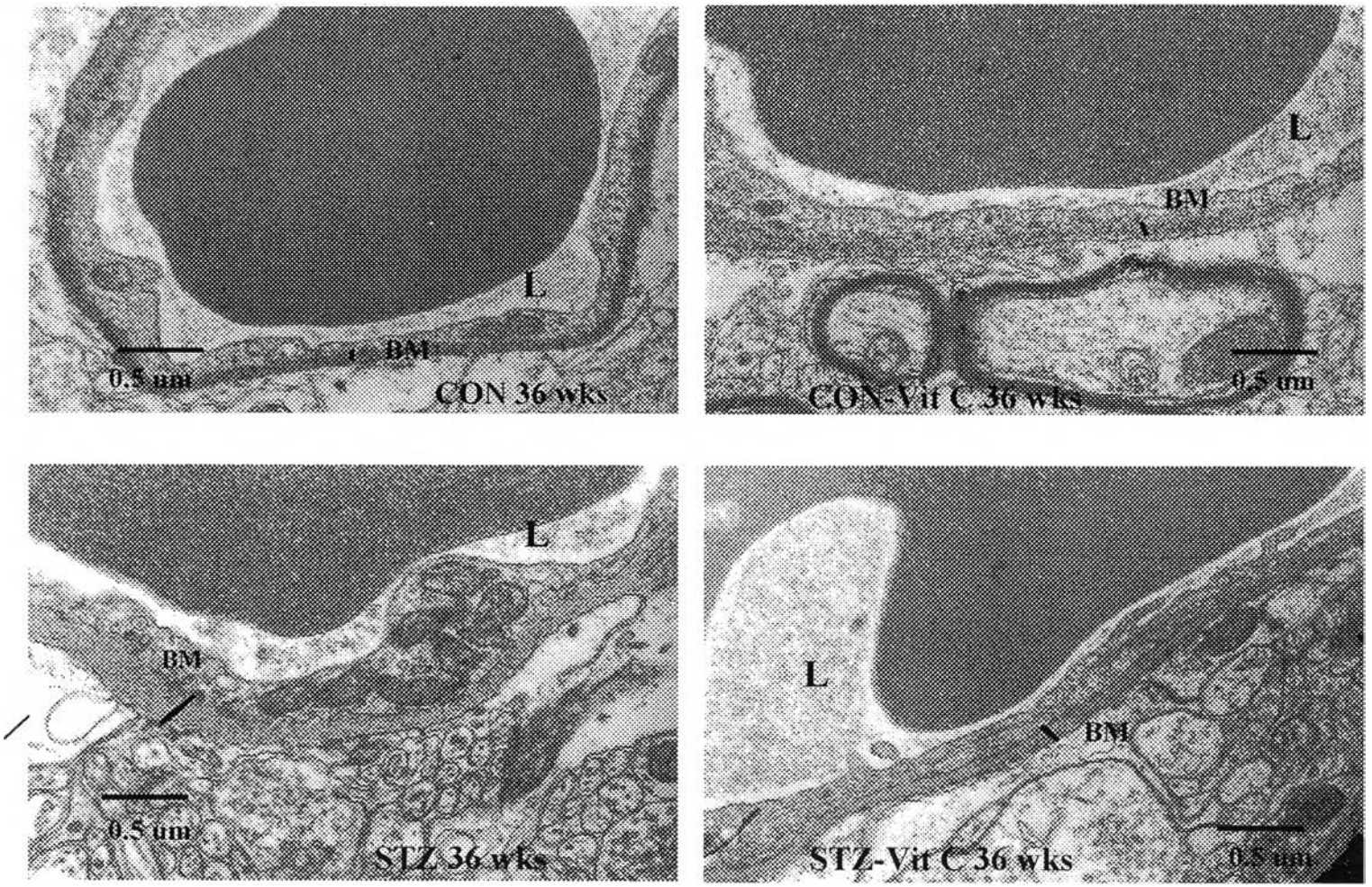


Figure 30 TEM photomicrograph of cerebral capillary (4-7um) from 36 wks of control and STZ-rats with and without vitamin C supplementation.Note greatly widened basement membrane (BM). L: capillary lumen.