

CHAPTER IV

RESULTS

After the animals were received 20% acetic acid to induce gastric ulcer. The animals were treated with sucralfate or *Aloe vera* as described. The effects of both treatments were studied and comparative at the experimental period of day 1 and day 8. The changes of gastric microcirculation, TNF α and IL-10 levels, and gastric ulcer healing were determined by using intravital fluorescent microscopy, ELISA, and H&E technique, respectively.

I. Effects of 20% acetic acid induced gastric ulcer on body weight and hemodynamic changes.

The body weight of animals from all groups were measured before the experiment, Means \pm SE of body weight on day 1 and day 8 were shown in Table 4.1 and 4.2. The results showed that the body weight of the ulcer group (D1: 231.67 \pm 13.23; D8: 220.00 \pm 18.71 grams.) has no significantly difference from the control group (D1: 226.60 \pm 5.11; D8: 245.75 \pm 13.09 grams.) for both day 1 and day 8.

On the experimental day, the carotid artery was canulated for recording hemodynamic changes by using polygraph (Nihon Kohden). The results were shown that systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) were not significantly difference between the control group (D₁: SBP: 114.17 \pm 10.33, DBP: 98.75 \pm 9.21, MAP: 93.61 \pm 8.97; D₈: SBP: 103.75 \pm 9.16,

DBP: 84.17 ± 5.16 , MAP: 88.20 ± 11.22 mmHg.) and the ulcer group (D₁: SBP: 113.33 ± 6.38 , DBP: 92.63 ± 6.72 , MAP: 85.72 ± 7.24 ; D₈: SBP: 103.34 ± 7.23 , DBP: 84.17 ± 5.16 , MAP: 77.77 ± 4.59 mmHg). The means \pm S.E of systolic blood pressure, diastolic blood pressure, and mean arterial blood pressure on day 1 and day 8 were summarized in Table 4.3 and 4.4.

II. The effect of 20% acetic acid induced gastric ulcer on leukocyte-endothelial cells interaction.

After the administration of 20 % acetic acid induced gastric ulcer on day 1 and day 8, the animals were observed for the leukocyte adherence on endothelial cells of postcapillary venules (diameter ~ 15 - 35 μm .) of gastric microcirculation by using the intravital fluorescence microscopy. The leukocyte that adhered on postcapillary venules for 30 seconds or longer were counted per each field of observation. The means number of leukocyte adherence in the ulcer group (D₁: 13.13 ± 1.19 ; D₈: 13.61 ± 1.99 cells/field) were significant increased compared to the control group (D₁: 1.69 ± 0.17 ; D₈: 5.53 ± 0.65 cells/field), in both day 1 and day 8. The means \pm SE of leukocyte adherence on day 1 and day 8 were summarized in Table 4.5 and Figure 4.1. The intravital microscopic demonstration of leukocyte adherence on day 1 and day 8 were shown in Figure 4.2 and 4.3, respectively.

III. The effect of 20% acetic acid induced gastric ulcer on the changes of TNF- α and IL-10 levels.

From the ELISA technique for determination of TNF- α and IL-10 levels, the resulted showed that after the administration of 20% acetic acid induced gastric ulcer, the levels of TNF- α (D₁: 151.40 \pm 26.87; D₈: 280.44 \pm 67.02 pg/ml.) were significantly higher than their control group (D₁: 12.51 \pm 2.35; D₈: 133.50 \pm 20.95 pg/ml.) both on day 1 and day 8. However, the levels of IL-10 after the administration of 20% acetic acid induced gastric ulcer (D₁: 472.66 \pm 167.75; D₈: 646.60 \pm 118.92 pg/ml.) were significantly lower than their control group (D₁: 911.46 \pm 230.81; D₈: 883.98 \pm 227.62 pg/ml.) both on day 1 and day 8. The means \pm SE of TNF- α levels on day 1 and day 8 were shown in Table 4.6 and Figure 4.4. The means \pm SE of IL-10 levels on day 1 and day 8 were shown in Table 4.7 and Figure 4.5.

IV. The effect of 20% acetic acid induced gastric ulcer on the pathology changes.

At the end of each intravital fluorescent microscopic experiment, the stomach were removed and cut along greater curvature. After that, the stomach was washed with 0.9% normal saline and taken picture for further the gross pathological study. On day 1 after the administration of 20% acetic acid induced gastric ulcer, the stomach was shown hemorrhage, edema of gastric tissue, and gastric lesion. On day 8 after induced gastric ulcer, the edema of gastric tissue was still observed in the ulcer group. The gross pathological of stomach of the control group and

the ulcer group on day 1 and day 8 were shown in Figure 4.6 and 4.7, respectively.

After that, the stomach was fixed in 10% formaline for further histopathology examination under the pathologist's guidance. On day 1 after the orogastric administration of 20% acetic acid, the histopathological examination were shown hemorrhage, congestion and edema in the gastric mucosa with mild to moderated leukocytic infiltration in gastric lesion. The gastric lesions were seen both erosive and ulcerative lesion. Whereas in the control group, there were only congestion, edema, and erosive lesion. Moreover, the means maximum length of gastric ulcer in the ulcer group (4.17 ± 0.11 cms.) was significantly longer than the control group (3.25 ± 0.11 cms.) ($p < 0.05$). On day 8 after induced gastric ulcer, the gastric ulcer pathology of both the control group and the ulcer group still found mild congestion and edema in gastric mucosa, mild leukocyte infiltration in gastric mucosa and erosive lesion. The means maximum length of gastric ulcer in the ulcer group (3.48 ± 0.10 cms.) still longer than the control group (3.20 ± 0.22 cms.). The data of histopathological changes in the control groups and the ulcer groups on day 1 and day 8 were summarized in Table 4.8 and 4.11, respectively. The images of histopathology changes of the control group and the ulcer group on day 1 and day 8 were shown in Figure 4.8 and 4.9, respectively. The means \pm SE of the maximum length of gastric ulcer was shown in Table 4.13 and Figure 4.10.

V. The effect of *Aloe vera* on body weight and hemodynamic changes compare to sucralfate.

The body weight of the ulcer treated with sucralfate group and the ulcer treated with *Aloe vera* group were measured, the means \pm SE of body weight on day 1 and day 8 were shown in Table 4.1 and 4.2. The results showed that the ulcer treated with sucralfate group (D₁: 264.25 \pm 2.95; D₈: 236.00 \pm 20.08 grams.) and the ulcer treated with *Aloe vera* group (D₁: 248.25 \pm 12.13; D₈: 255.13 \pm 19.04 grams.) had no significantly difference from the control group (D₁: 226.60 \pm 5.11; D₈: 245.75 \pm 13.09 grams.) and of the ulcer group (D₁: 231.67 \pm 13.23; D₈: 220.00 \pm 18.71 grams.) both on day 1 and day 8. *Aloe vera* and sucralfate treatment no effect on change of body weight after induced gasitric ulcer.

After carotid artery was canulated, hemodynamic changes were recorded by using polygraph. The results were shown that systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial blood pressure (MAP) were no significant difference between the ulcer treated with sucralfate group (D₁: SBP: 111.25 \pm 5.42, DBP: 85.42 \pm 4.68, MAP: 76.80 \pm 5.47; D₈: SBP: 120.00 \pm 10.93, DBP: 97.09 \pm 8.51, MAP: 89.45 \pm 7.82 mmHg.) and the ulcer treated with *Aloe vera* group (D₁: SBP: 104.58 \pm 8.78, DBP: 86.67 \pm 8.85, MAP: 80.70 \pm 9.38; D₈: SBP: 102.92 \pm 6.25, DBP: 82.92 \pm 3.69, MAP: 76.25 \pm 3.07 mmHg). Moreover, SBP, DBP, and MAP also shown no significant difference compared to the control group (D₁: SBP: 114.17 \pm 10.33, DBP: 98.75 \pm 9.21, MAP: 93.61 \pm 8.97; D₈: SBP: 103.75 \pm 9.16, DBP: 84.17 \pm 5.16, MAP: 88.20 \pm 11.22 mmHg.) and the ulcer group (D₁: SBP: 113.33 \pm 6.38, DBP: 92.63 \pm 6.72, MAP: 85.72 \pm 7.24; D₈: SBP: 103.34 \pm 7.23, DBP: 84.17 \pm 5.16, MAP:

77.77 ± 4.59 mmHg) both on day 1 and day 8 after induced gastric ulcer. The means ± S.E of systolic blood pressure, diastolic blood pressure and mean arterial blood pressure on day 1 and day 8 were shown in Table 4.3 and 4.4.

VI. The effect of *Aloe vera* on leukocyte-endothelium interaction in postcapillary venule compare to sucralfate.

From the intravital fluorescent microscopic study, the number of leukocyte adherence on postcapillary venule for 30 seconds or longer were counted per each field of study using image analysis software. On day 1 and day 8 after induced gastric ulcer, the ulcer treated with sucralfate group (D1: 3.22 ± 0.76; D8: 3.80 ± 0.79 cells/field) and the ulcer treated with *Aloe vera* group (D1: 4.29 ± 0.39; D8: 4.46 ± 0.27 cells/field) was significantly (P<0.05) decreased the numbers of the leukocyte adherence both on day 1 and day 8 when compared to the ulcer group (D1: 13.13 ± 1.19; D8: 13.61 ± 1.99 cells/field). The ulcer treated with *Aloe vera* could reduce the number of leukocyte adherence in the same manner as the ulcer treated with sucralfate group. The means ± SE of leukocyte adherence on day 1 and day 8 were shown in Table 4.5 and Figure 4.1. The intravital microscopic images of leukocyte adherence for on day 1 and day 8 were shown in Figure 4.2 and 4.3, respectively.

VII. The effect of *Aloe vera* on TNF-α and IL-10 level compare to sucralfate.

From the ELISA technique for measured TNF-α and IL-10 levels. The levels of TNF-α in the ulcer treated with sucralfate group (138.62 ±

47.45 pg/ml.) and the ulcer treated with *Aloe vera* group (153.02 ± 26.90 pg/ml) were higher than the control group (12.51 ± 2.35 pg/ml.) on day 1. On day 8, the levels of TNF- α in the ulcer treated with sucralfate group (170.21 ± 23.82 pg/ml.) and the ulcer treated with *Aloe vera* group (154.32 ± 43.55 pg/ml) were significantly ($p < 0.05$) lower than the ulcer group (280.44 ± 67.02 pg/ml.) and not different from the control group (133.50 ± 20.95 pg/ml.). The ulcer treated with *Aloe vera* could reduce TNF- α level in the same manner as the ulcer treated with sucralfate group. The means of TNF- α level on day 1 and day 8 were shown in Table 4.6 and Figure 4.4.

Furthermore, the level of IL-10 in the ulcer treated with sucralfate group (D₁: 1419.93 ± 359.81; D₈: 1283.64 ± 179.72 pg/ml) and in the ulcer treated with *Aloe vera* group (D₁: 1178.13 ± 159.87; D₈: 984.02 ± 269.26 pg/ml.) was higher than the ulcer group (D₁: 472.66 ± 167.75; D₈: 646.60 ± 118.92 pg/ml.) both on day 1 and day 8 after induced gastric ulcer. The means ± SE of IL-10 level on day 1 and day 8 were shown in Table 4.7 and Figure 4.5.

IV. The effect of *Aloe vera* on gastric ulcer healing compare to sucralfate.

On day 1 after the orogastric administration of 20% acetic acid and treatment, the histopathological examination were shown hemorrhage, congestion and edema in the gastric mucosa with mild to moderate of leukocytic infiltration and gastric lesions. The gastric lesions were both erosive and ulcerative. The means maximum length of gastric ulcer in the ulcer treated with sucralfate group (3.73 ± 0.12 cms.) and the ulcer

treated with *Aloe vera* group (3.60 ± 0.18 cms.) were reduced after treatment when compared to the ulcer group (4.17 ± 0.11 cms.). Therefore, sucralfate and *Aloe vera* treatment could reduce the length of gastric ulcer.

On day 8, the gastric of those group still found mild congestion and edema in the gastric mucosa, mild leukocytic infiltration in submucosa of gastric and erosive lesions. The means maximum length of gastric ulcer in the ulcer treated with sucralfate group (3.33 ± 0.11 cms.) and the ulcer treated with *Aloe vera* group (3.43 ± 0.10 cms.) were slightly reduced but no significant difference after treatment when compared to the ulcer group (3.48 ± 0.10 cms.). Which its may be due to a spontaneous healing of gastric ulcer in the ulcer group. The data of histopathological changes in the ulcer treated with sucralfate group and the ulcer treated with *Aloe vera* group on day 1 and day 8 were shown as Table 4.9, 4.10, and 4.12. The gross pathology of stomach of the ulcer treated with sucralfate group and the ulcer treated with *Aloe vera* group both on day 1 and day 8 were shown as Figure 4.6 and 4.7, respectively. The histopathological images after the 20% acetic acid induced gastric ulcer and treatment were shown in Figure 4.8 and 4.9. The means \pm S.E of the maximum length of gastric ulcer were shown in Table 4.13 and Figure 4.10. The percent curation of gastric ulcer in the ulcer treated with *Aloe vera* group compared to the ulcer treated with sucralfate group on day 1 and day 8 after induced gastric ulcer. Interestingly, the histopathological examination found that there were proliferation, elongation and dilatation of oxyntic glands in the ulcer treated with sucralfate group and the ulcer treated with *Aloe vera* group both on day 1 and day 8. Therefore, sucralfate and *Aloe vera* treatment could promote ulcer healing.

Table 4.1 Means \pm SE of body weight (grams.) of the control, ulcer, ulcer treated with sucralfate, ulcer treated with *Aloe vera* groups on day 1 after induced gastric ulcer. (Each group n=4)

Group	Body weight (grams.)
	Day 1
Control	226.60 \pm 5.11
Ulcer	231.67 \pm 13.23 ^{no}
Ulcer + sucralfate	264.25 \pm 2.95 ^{no, ns}
Ulcer + <i>Aloe vera</i>	248.25 \pm 12.13 ^{no, ns, NS}

no No significant difference as compared to control

ns No significant difference as compared to ulcer

NS No significant difference as compared to sucralfate

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Table 4.2 Means \pm SE of body weight (grams.) of the control, ulcer, ulcer treated with sucralfate, ulcer treated with *Aloe vera* groups on day 8 after induced gastric ulcer. (Each group n=4)

Group	Body weight (grams.)
	Day 8
Control	245.75 \pm 13.09
Ulcer	220.00 \pm 18.71 ^{no}
Ulcer + sucralfate	236.00 \pm 20.08 ^{no}
Ulcer + <i>Aloe vera</i>	255.13 \pm 19.04 ^{no, ns, NS}

no No significant difference as compared to control

ns No significant difference as compared to ulcer

NS No significant difference as compared to sucralfate

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Table 4.3 Means \pm SE of systolic blood pressure, diastolic blood pressure and mean arterial blood pressure (mmHg) of the control, ulcer group, ulcer treated with sucralfate and the ulcer treated with *Aloe vera* groups on day 1. (Each group n=4)

Group	Systolic BP	Diastolic BP	MAP
Control	114.17 \pm 10.33	98.75 \pm 9.21	103.89 \pm 9.53
Ulcer	113.33 \pm 6.38 ^{no}	92.63 \pm 6.72 ^{no}	99.53 \pm 6.39 ^{no}
Ulcer + sucralfate	111.25 \pm 5.42 ^{no, ns}	85.42 \pm 4.68 ^{no, ns}	94.03 \pm 4.38 ^{no, ns}
Ulcer + <i>Aloe vera</i>	104.58 \pm 8.78 ^{no, ns, NS}	86.67 \pm 8.85 ^{no, ns, NS}	92.64 \pm 8.55 ^{no, ns, NS}

no No significant difference as compared to control

ns No significant difference as compared to ulcer

NS No significant difference as compared to sucralfate

$$\text{MAP} = 1/3 (\text{SBP} + 2\text{DBP})$$

Table 4.4 Means \pm SE of systolic blood pressure, diastolic blood pressure and mean arterial blood pressure (mmHg) of the control, ulcer, ulcer treated with sucralfate and ulcer treated with *Aloe vera* groups on day 8. (Each group n=4)

Group	Systolic BP	Diastolic BP	MAP
Control	103.75 \pm 9.16	92.09 \pm 10.66	95.98 \pm 10.12
Ulcer	103.34 \pm 7.23 ^{no}	84.17 \pm 5.16 ^{no}	90.55 \pm 5.80 ^{no}
Ulcer + sucralfate	120.00 \pm 10.93 ^{no, ns}	97.09 \pm 8.51 ^{no, ns}	103.47 \pm 9.68 ^{no, ns}
Ulcer + <i>Aloe vera</i>	102.92 \pm 6.25 ^{no, ns, NS}	82.92 \pm 3.69 ^{no, ns, NS}	89.52 \pm 4.46 ^{no, ns, NS}

no No significant difference as compared to control

ns No significant difference as compared to ulcer

NS No significant difference as compared to sucralfate

$$\text{MAP} = 1/3 (\text{SBP} + 2\text{DBP})$$

Table 4.5 Means \pm SE of leukocyte adherence on postcapillary venule of the control, ulcer, ulcer treated with sucralfate, and ulcer treated with *Aloe vera* groups. (Each group n=6)

Group	The means of leukocyte adherence(cells/field)	
	Day 1	Day 8
Control	1.69 \pm 0.17	5.53 \pm 0.65
ulcer	13.13 \pm 1.19*	13.61 \pm 1.99*
ulcer+sucralfate	3.22 \pm 0.76 ^{no,**}	3.80 \pm 0.79 ^{no,**}
ulcer+ <i>Aloe vera</i>	4.29 \pm 0.39 ^{no,**,NS}	4.46 \pm 0.27 ^{no,**,NS}

* Significant difference as compared to control (p<0.05)

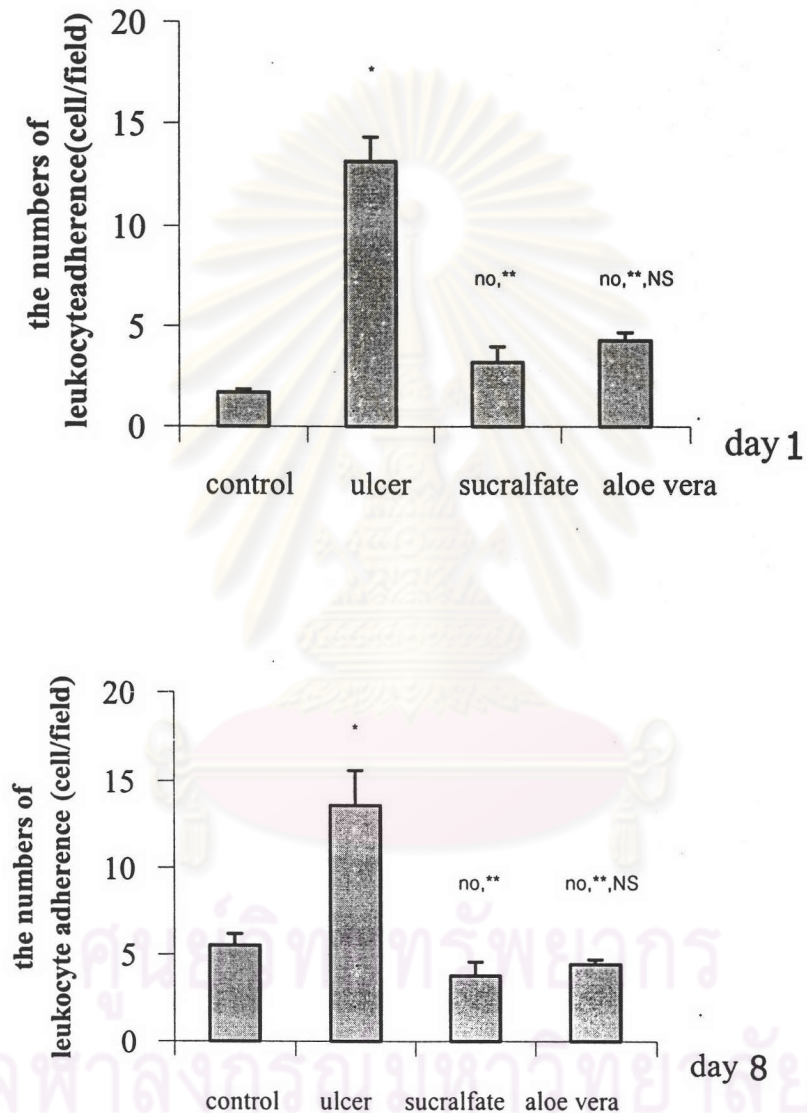
** Significant difference as compared to ulcer (p<0.05)

no No significant difference as compared to control

NS No significant difference as compared to sucralfate

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Figure 4.1 Means \pm SE of leukocyte adherence on postcapillary venule in the control, ulcer, ulcer treated with sucralfate, and ulcer treated with *Aloe vera* groups. (Each group n=6)



* Significant difference as compared to control ($p < 0.05$)

** Significant difference as compared to ulcer ($p < 0.05$)

no No significant difference as compared to control

ns No significant difference as compared to control

NS No significant difference as compared to sucralfat

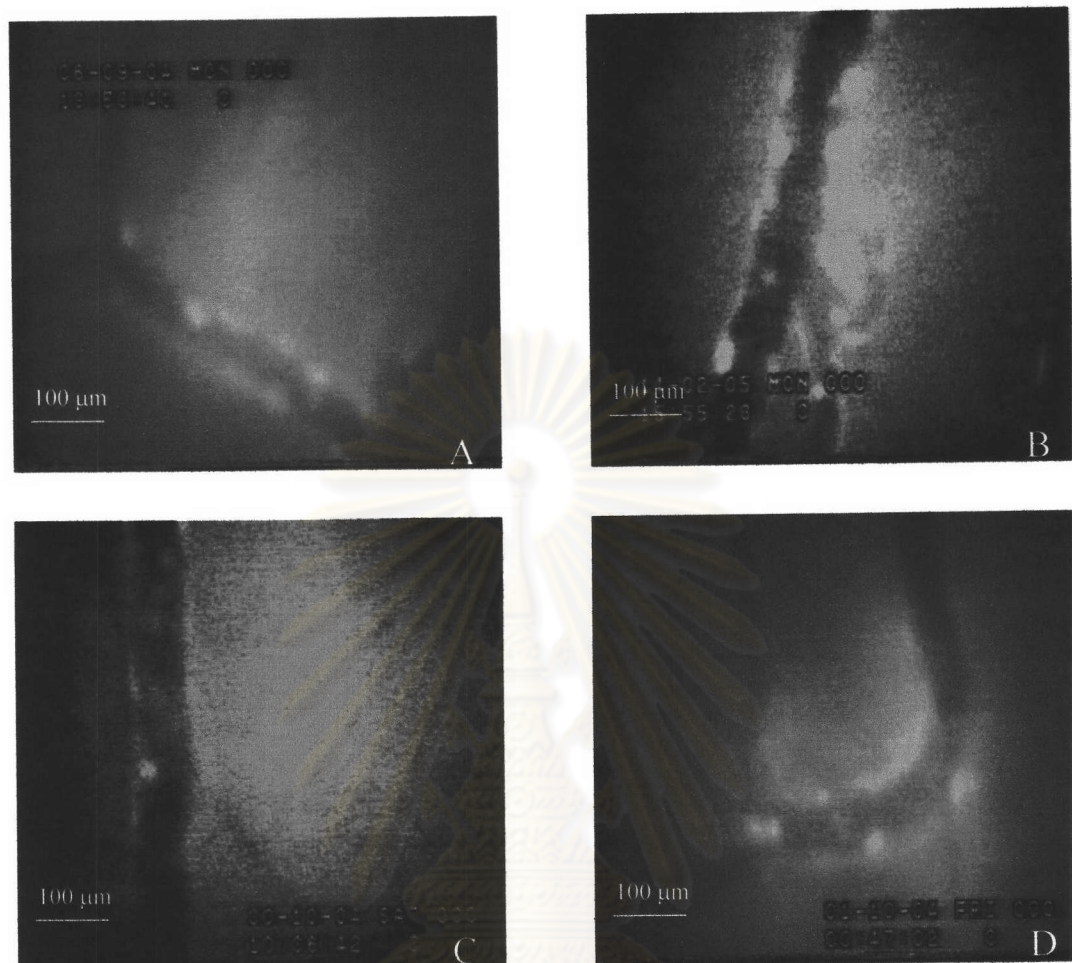


Figure 4.2 The intravital microscopic ($\times 40$) images of leukocyte adherence on vascular endothelium of postcapillary venule in control group (A), ulcer group (B), ulcer treated with sucralfate group (C), ulcer treated with *Aloe vera* group (D) on day 1. Images showed that the numbers of leukocyte adherence were increased in the ulcer group when compared to the control group. *Aloe vera* and sucralfate treatment could reduce the numbers of leukocyte adherence.

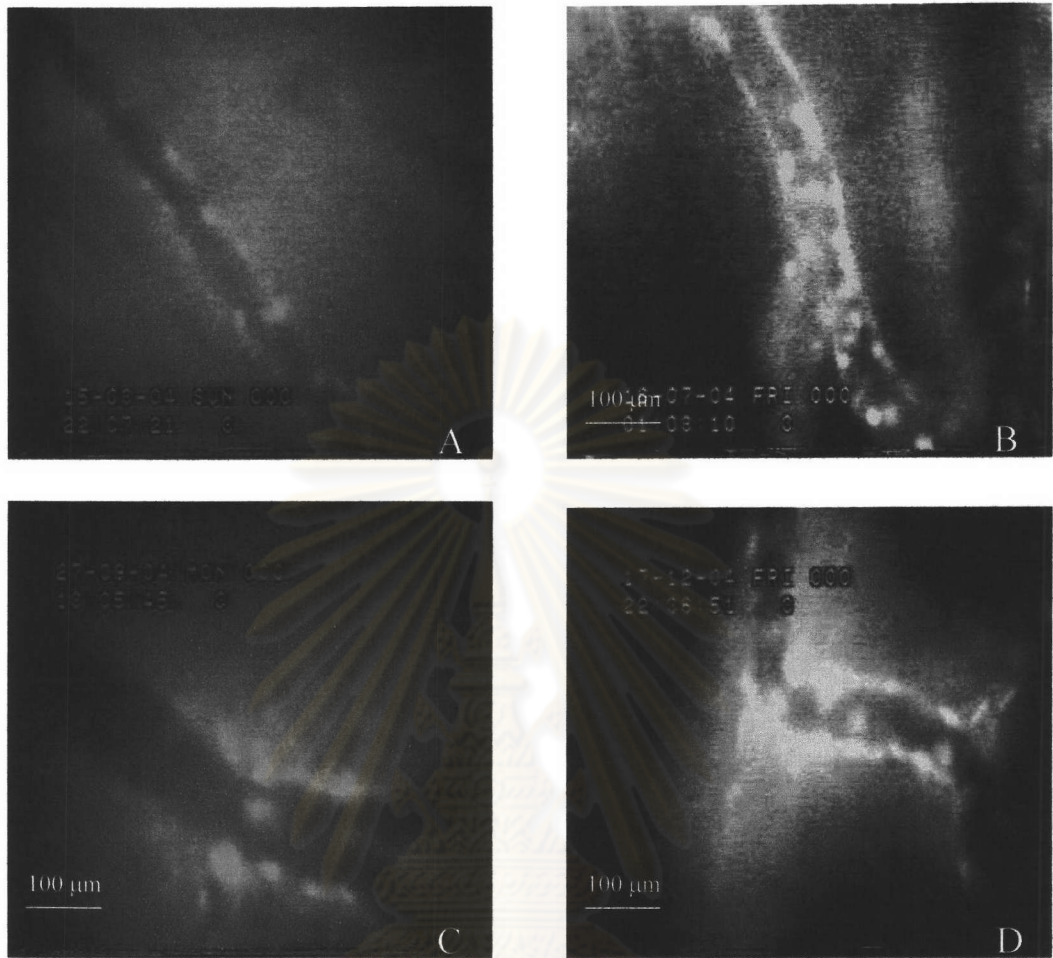


Figure 4.3 The intravital microscopic ($\times 40$) images of leukocyte adherence on vascular endothelium of postcapillary venule in control group (A), ulcer group (B), ulcer treated with sucralfate group (C), ulcer treated with *Aloe vera* group (D) on day 8. Images showed that the numbers of leukocyte adherence were increased in the ulcer group when compared to the control group. *Aloe vera* and sucralfate treatment could reduce the numbers of leukocyte adherence.

Table 4.6 Means \pm SE of TNF- α level in the control, ulcer, ulcer treated with sucralfate, and ulcer treated with *Aloe vera* groups. (Each group n=5)

Group	Serum TNF- α level (pg/ml)	
	Day 1	Day 8
Control	12.51 \pm 2.35	133.50 \pm 20.95
Ulcer	151.40 \pm 26.87*	280.44 \pm 67.02*
Ulcer + sucralfate	138.62 \pm 47.45*, ns	170.21 \pm 23.82 no,**
Ulcer + <i>Aloe vera</i>	153.02 \pm 26.90*, ns, NS	154.32 \pm 43.55 no,**, NS

* Significant difference as compared to control (p<0.05)

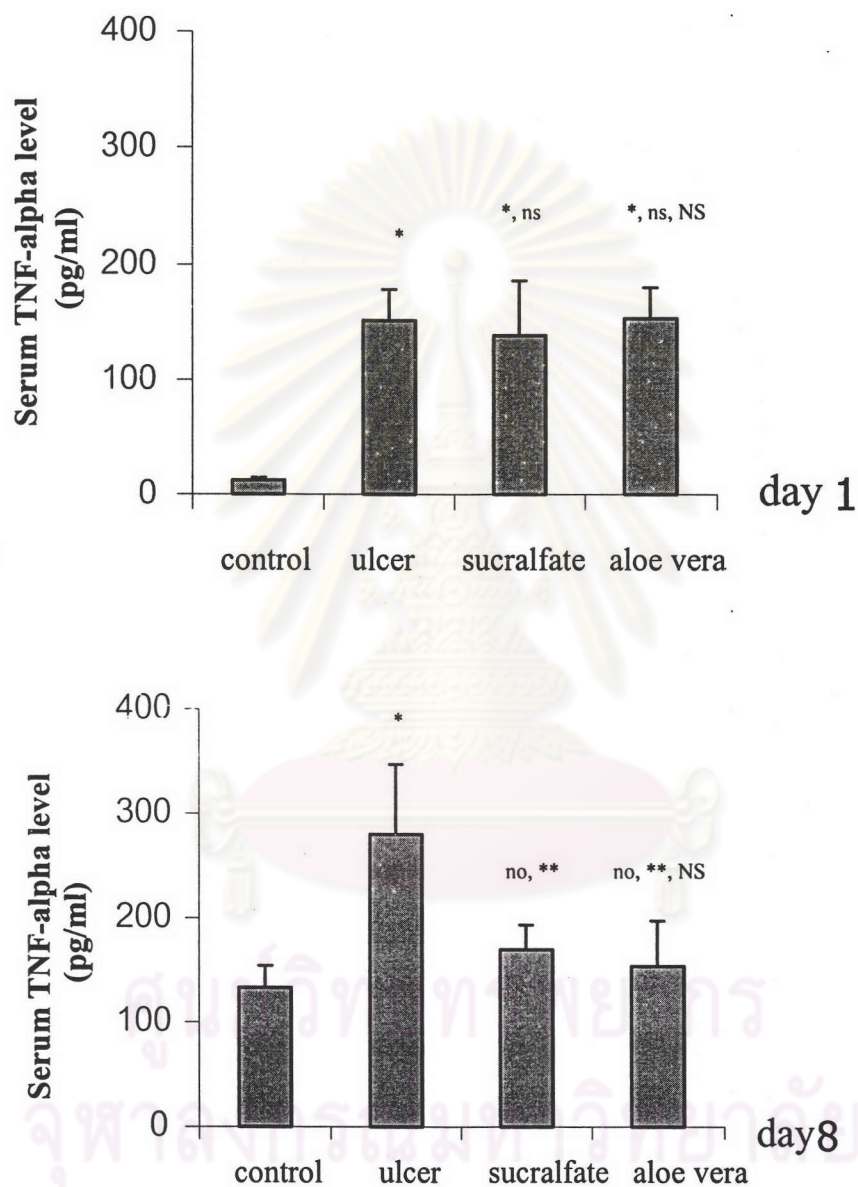
** Significant difference as compared to ulcer (p<0.05)

no No significant difference as compared to control

ns No significant difference as compared to ulcer

NS No significant difference as compared to sucralfate

Figure 4.4 Means \pm SE of TNF- α level in the control, ulcer, ulcer treated with sucralfate, and ulcer treated with *Aloe vera* groups. (Each group n=5)



* Significant difference as compared to control ($p < 0.05$)

** Significant difference as compared to ulcer ($p < 0.05$)

no No significant difference as compared to control

ns No significant difference as compared to ulcer

NS No significant difference as compared to sucralfate

Table 4.7 Means \pm SE of IL-10 level in the control, ulcer, ulcer treated with sucralfate, and ulcer treated with *Aloe vera* groups. (Each group n=5)

Group	Serum IL-10 level (pg/ml)	
	Day 1	Day 8
Control	911.46 \pm 230.81	883.98 \pm 227.62
Ulcer	472.66 \pm 167.75 ^{no}	646.60 \pm 118.92 ^{no}
Ulcer + sucralfate	1419.93 \pm 359.81 ^{no,**}	1283.64 \pm 179.72 ^{no,ns}
Ulcer + <i>Aloe vera</i>	1178.13 \pm 159.87 ^{no,**,NS}	984.02 \pm 269.26 ^{no,ns,NS}

* Significant difference as compared to control (p<0.05)

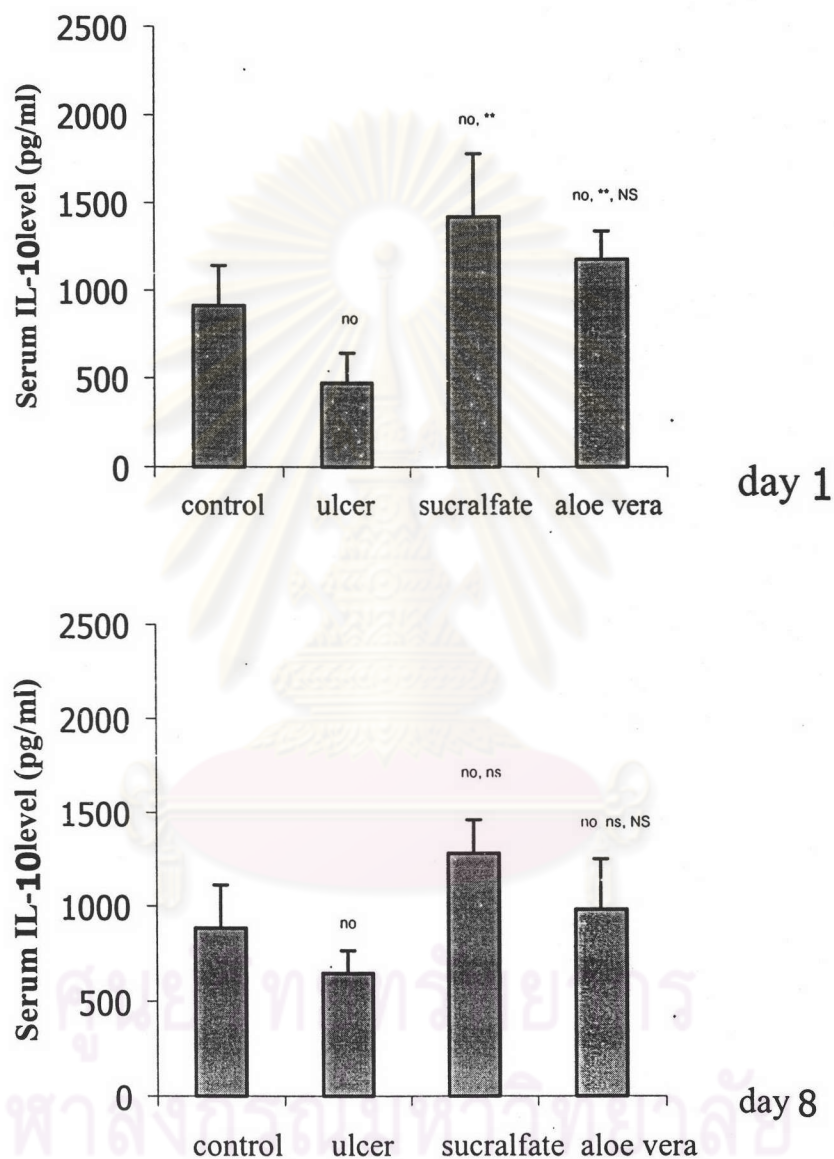
** Significant difference as compared to ulcer (p<0.05)

no No significant difference as compared to control

ns No significant difference as compared to ulcer

NS No significant difference as compared to sucralfate

Figure 4.5 Means \pm SE of IL-10 level in the control, ulcer, ulcer treated with sucralfate, and ulcer treated with *Aloe vera* groups. (Each group n=5)



* Significant difference as compared to control ($p < 0.05$)

** Significant difference as compared to ulcer ($p < 0.05$)

no No significant difference as compared to control

ns No significant difference as compared to ulcer

Ns No significant difference as compared to sucralfate

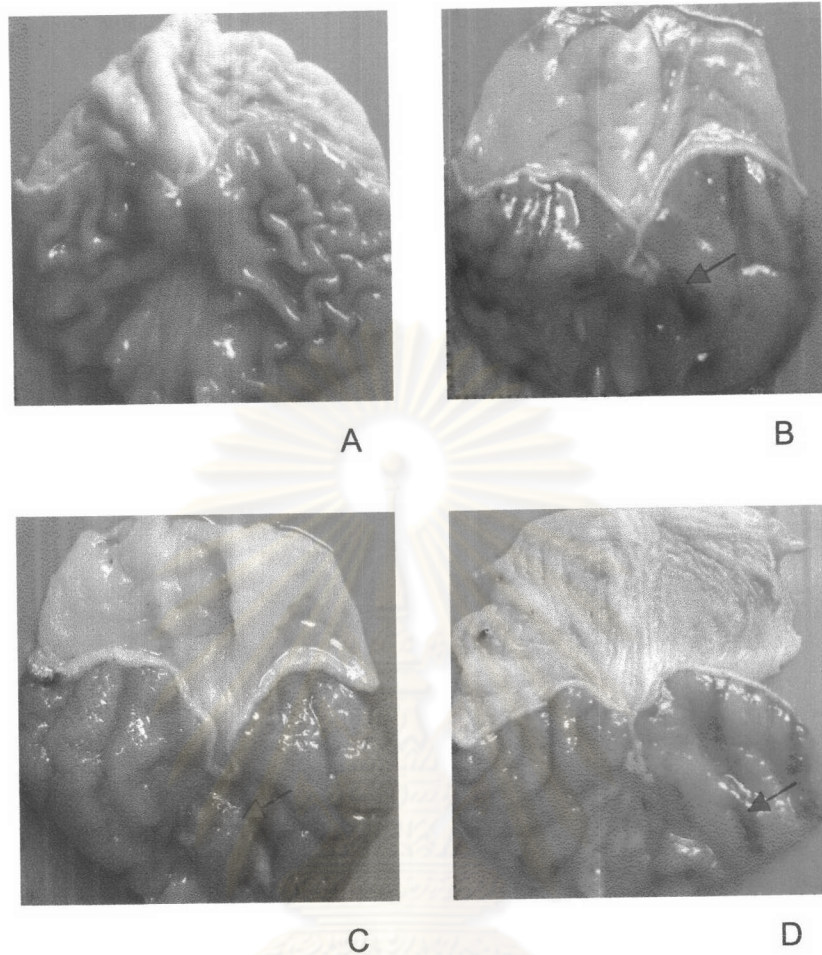


Figure 4.6 The gross pathology of stomach of control group (A), ulcer group (B), ulcer treated with sucralfate group (C), and ulcer treated with *Aloe vera* group (D) on day 1. After the administration of 20% acetic acid induced gastric ulcer. The stomach was observed for hemorrhage, edema of gastric tissue, and gastric lesion.

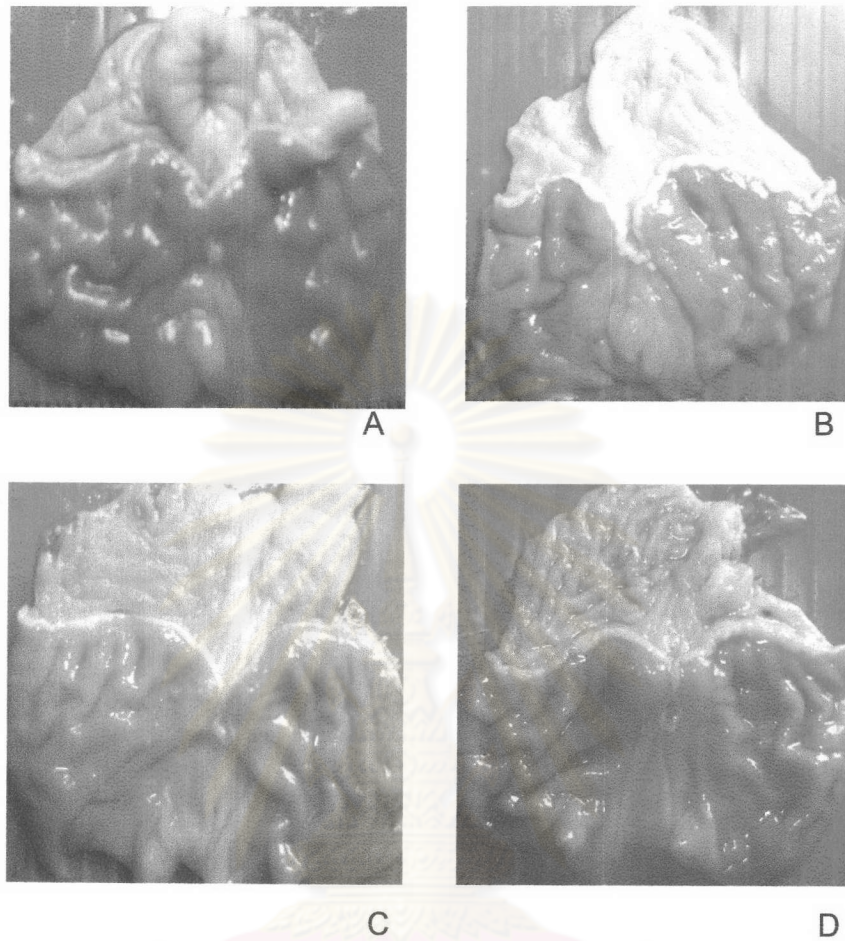


Figure 4.7 The gross pathology of stomach of control group (A), ulcer group (B), ulcer treated with sucralfate group (C), and ulcer treated with *Aloe vera* group (D) on day 8. From the photographs showed that the ulcer group still edema of gastric tissue but the other group did not find any abnormal of the stomach.

Table 4.8 Histopathological changes in the control group and the ulcer group on day 1 after induced gastric ulcer.

Group	histopathological changes
Control	
No. 1	-Scattered erosion, congestion and edema of submucosa
No. 2	-Surface erosion, congestion and edema of mucosa and submucosal layer, sparse inflammatory cell infiltration in submucosa (lymphocytes)
No. 3	-Mild focal surface erosion and hemorrhage, edema and congestion of submucosa, sparse lymphocytes
No. 4	-Mild surface erosion, moderate congestion and edema of mucosa and submucosa, sparse lymphocytes
No. 5	-Mild surface erosion, sparse inflammation
No. 6	-Focal surface erosion, mild congestion and edema of submucosa, scanty lymphocytes
Ulcer group	
No. 1	-Severe extensive hemorrhagic necrosis of mucosa and moderate to marked acute inflammatory cells extending to submucosa and muscular layer as well as perigastric fat
No. 2	-Surface erosion, segmental ulcerative necrosis (50%) with mild to moderate acute inflammatory cell infiltration, diffuse congestion and hemorrhage, mild diffuse acute and chronic inflammatory cell infiltration
No.3	-Focal surface erosion with scant inflammatory cell infiltration, sparse lymphocytic infiltrate in edematous lamina propria
No.4	-Severe extensive hemorrhage necrosis of mucosa and moderate to marked acute inflammatory cells extending to mucosa and submucosa as well as perigastric fat, focal hemorrhage
No.5	-Severe extensive hemorrhagic necrosis of mucosa and moderate acute inflammatory cells extending to mucosa and submucosa as well as perigastric fat, focal hemorrhage
No.6	-Focal surface erosion with scant inflammatory cell infiltration, sparse lymphocytic infiltrate in edematous lamina propria

Table 4.9 Histopathological changes in the ulcer treated with sucralfate group on day 1 after induced gastric ulcer.

Group	Histopathological changes
Ulcer+sucralfate group	
No.1	-Surface erosion, focal ulcer and hemorrhage, mild congestion and edema of submucosa, mild lymphocytes infiltration in submucosa, elongation and dilatation of oxyntic glands
No. 2	-Surface erosion, scattered ulcer and hemorrhage, mild congestion and edema of mucosa and submucosa, mild lymphocytes infiltration in submucosa, elongation and dilatation of oxyntic glands
No. 3	-Surface erosion, focal ulcer and hemorrhage, mild congestion and edema of submucosa, mild lymphocytes infiltration in submucosa, surface regeneration, proliferation, elongation and dilatation of oxyntic glands
No. 4	-Surface erosion, focal ulcer and hemorrhage, mild congestion and edema of submucosa, mild lymphocytes infiltration in submucosa, surface regeneration, proliferation, elongation and dilatation of oxyntic glands
No. 5	-Surface erosion, focal ulcer and hemorrhage, mild congestion and edema of submucosa, mild lymphocytes infiltration in submucosa, mild proliferation, elongation and dilatation of oxyntic glands
No. 6	-Mild surface erosion, mild congestion and edema of submucosa, mild lymphocytes infiltration in submucosa, moderated proliferation, elongation and dilatation of oxyntic glands

Table 4.10 Histopathological changes in the ulcer treated with *Aloe vera* group on day 1 after induced gastric ulcer.

Group	Histopathological changes
Ulcer+<i>Aloe vera</i> group	
No. 1	-Scattered ulcer & hemorrhage of mucosa, congestion and edema of submucosa containing lymphocytes, proliferation and elongation of oxyntic glands
No. 2	-Extensive hemorrhagic necrosis and ulcer, congestion and edema of submucosa, moderate to severe inflammation in mucosa and submucosa
No. 3	-Scattered erosion and focal ulcer, congestion and edema of mucosa and submucosa, mild inflammation
No. 4	-Extensive hemorrhagic necrosis and ulceration of mucosa, diffuse hemorrhage congestion and edema, moderate inflammation
No. 5	-Focal surface erosion with scant inflammatory cell infiltration, sparse lymphocytic infiltrate in edematous lamina propria
No. 6	-Focal surface erosion with scant inflammatory cell infiltration, sparse lymphocytic infiltrate in edematous lamina propria

Table 4.11 Histopathological changes in the control group and the ulcer group on day 8 after induced gastric ulcer.

Group	Histopathological changes
Control	
No. 1	-Focal surface erosion, moderate congestion and edema of submucosa, sparse lymphocytes
No. 2	-Mild surface erosion, mild edema of submucosa
No. 3	-Mild congestion and edema of submucosa, sparse lymphocytes
No. 4	-Focal surface erosion, mild congestion and edema of mucosa and submucosa
No. 5	-Mild surface erosion, congestion and edema of mucosa and submucosa, sparse lymphocytes
No. 6	-Diffuse mild congestion and edema of mucosa and submucosa
Ulcer group	
No.1	-Scattered subacute ulcer (lymphocytes, plasma cells and eosinophils), reactive atypia of epithelium, congestion and edema of submucosa, focal lymphoplasmacytic infiltrates in submucosa
No. 2	-Scattered subacute ulcer (lymphocytes, plasma cells and eosinophils), reactive atypia of epithelium, mild congestion and edema of submucosa, focal lymphoplasmacytic infiltrates in submucosa
No.3	-Mild surface erosion, mild congestion and edema of submucosa
No. 4	-Focal surface erosion, mild congestion and edema of mucosa and submucosa, sparse lymphocytes
No. 5	-Scattered surface erosion, mild congestion and edema of submucosa, regeneration of mucosa
No. 6	-Focal surface erosion with scant inflammatory cell infiltration, sparse lymphocytic infiltrate in edematous lamina propria

Table 4.12 Histopathological changes in the ulcer treated with sucralfate group and the ulcer treated with *Aloe vera* group on day 8 after induced gastric ulcer.

Group	Histopathological changes
Ulcer+sucralfate group	
No. 1	-Ulcer, moderate inflammation mucosa and submucosa, proliferation and elongation of oxyntic glands
No. 2	-Mild surface erosion, mildly inflammation, mild congestion of submucosa, focal healing ulcer
No. 3	-Mild surface erosion, mildly inflammation, mild congestion and edema of submucosa, proliferation and elongation of oxyntic glands, focal healing ulcer
No. 4	-Mild surface erosion, mildly inflammation, mild congestion and edema of submucosa, proliferation and elongation of oxyntic glands
No. 5	-Mild surface erosion, mildly inflammation, mild congestion and edema of submucosa, proliferation and elongation of oxyntic glands, focal healing ulcer
No. 6	-Focal surface erosion, mildly inflammation, mild congestion of submucosa, mild lymphocytic infiltrate
Ulcer+<i>Aloe vera</i> group	
No. 1	-Mild surface erosion, regenerative atypia of epithelium, increase neuroendocrine proliferation, proliferation and elongation of oxyntic glands
No. 2	-Mild surface erosion, regenerative atypia of epithelium, diffuse congestion
No. 3	-Mild surface erosion, moderate congestion and edema of submucosa, moderate inflammation
No. 4	-Mild surface erosion, mild edema of submucosa, mild inflammation, proliferation and elongation of oxyntic glands
No. 5	-Focal surface erosion with scant inflammatory cell infiltration, sparse lymphocytic infiltrate in edematous lamina propria, proliferation and elongation of oxyntic glands
No. 6	-Focal surface erosion with scant inflammatory cell infiltration, sparse lymphocytic infiltrate in edematous lamina propria, proliferation, elongation and dilatation of oxyntic gland

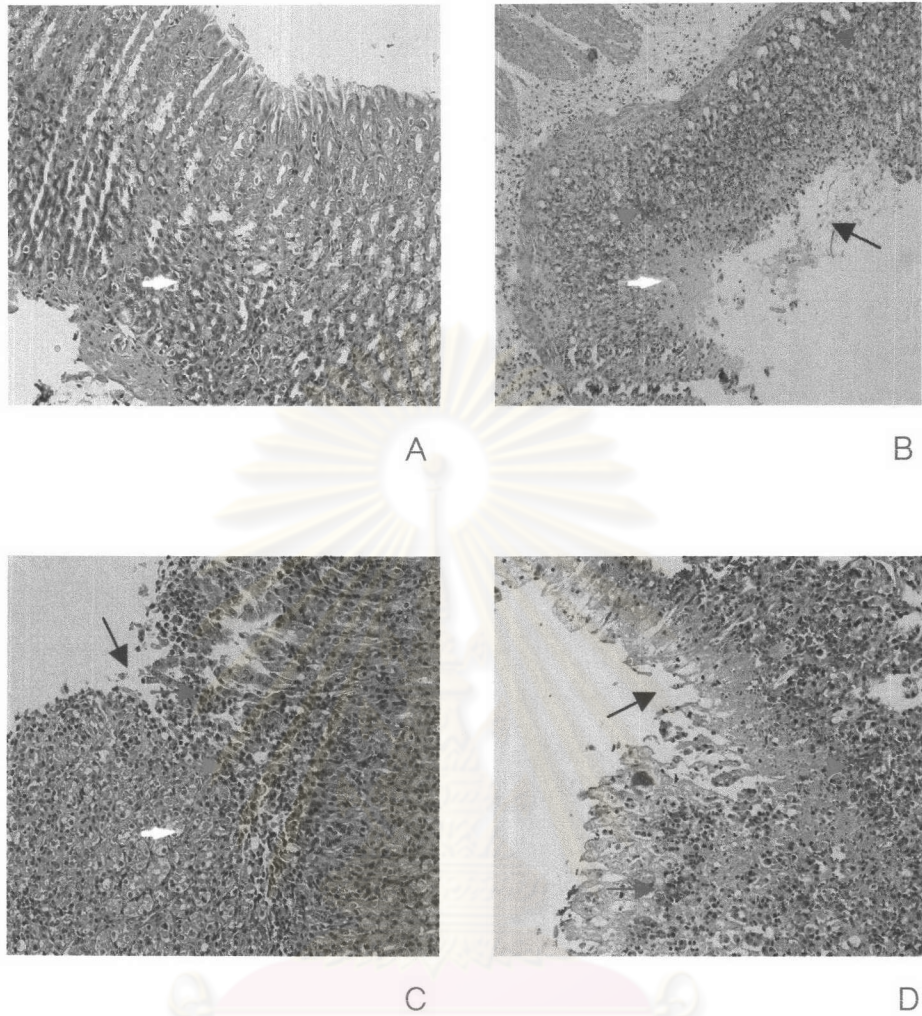


Figure 4.8 Histopathology images of control group (A), ulcer group (B), ulcer treated with sucralfate group (C), and ulcer treated with *Aloe vera* group (D) on day 1. After the administration of 20% acetic acid, the histopathological examination showed that the stomach was been hemorrhage (orange), congestion and edema of gastric mucosa, leukocyte infiltration in gastric ulcer (blue), and gastric ulcer (green) after the administration of 20% acetic acid. (Hematoxylin and eosin; magnification $\times 20$).

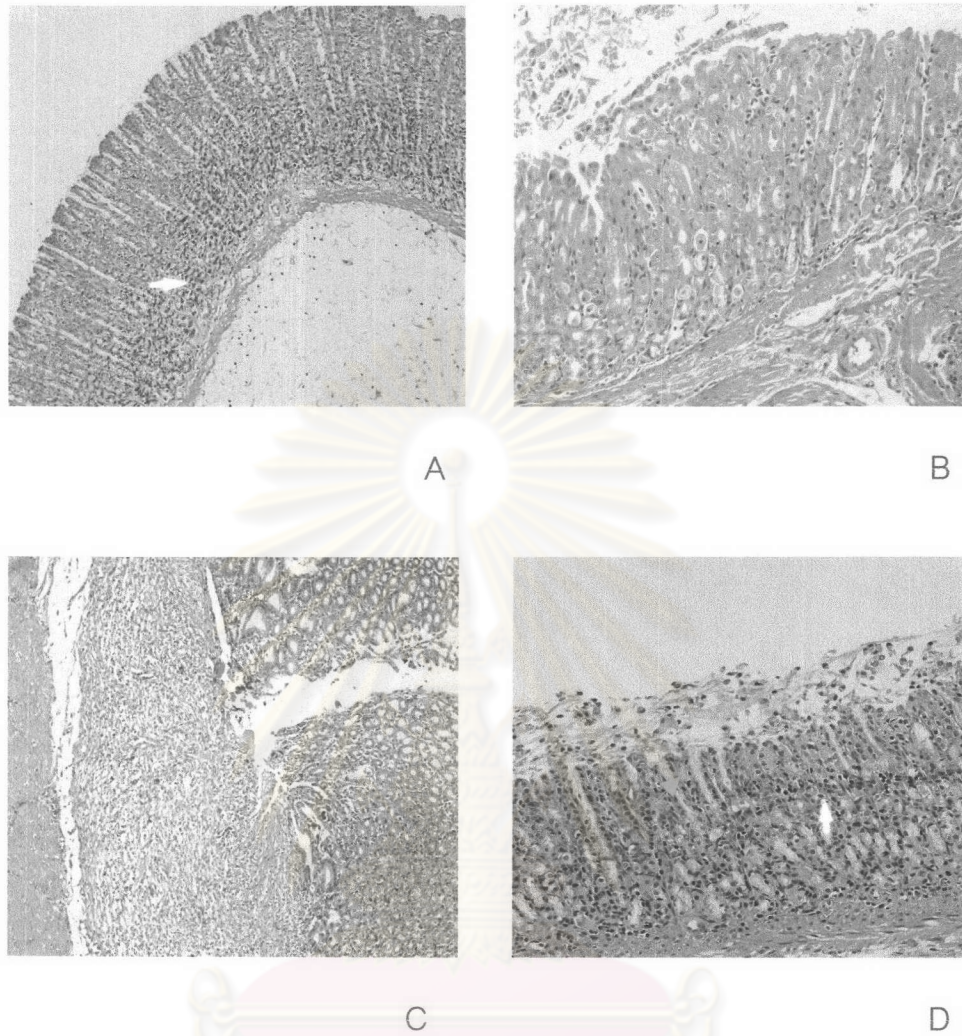


Figure 4.9 Histopathology image of control group (A), ulcer group (B), ulcer treated with sucralfate group (C), and ulcer treated with *Aloe vera* group (D) on day 8. The histopathological examination showed that the stomach still mild congestion and edema of gastric mucosa, and mild leukocytic infiltration in gastric mucosa. Moreover, in *Aloe vera* and sucralfate treatment group found proliferation, and elongation of oxyntic gland (yellow). (Hematoxylin and eosin; magnification $\times 20$).

Table 4.13 Means \pm S.E of the maximum length of gastric ulcer (cms.) of the control, ulcer group, ulcer treated with sucralfate group, and ulcer treated with *Aloe vera* groups. (Each group n=6)

Group	Maximum length of gastric ulcer (cms.)	
	Day 1	Day 8
Control	3.25 \pm 0.11	3.20 \pm 0.22
Ulcer	4.17 \pm 0.11 *	3.48 \pm 0.10 ^{no}
Ulcer + sucralfate	3.73 \pm 0.12 *,**	3.33 \pm 0.11 ^{no, ns}
Ulcer + <i>Aloe vera</i>	3.60 \pm 0.18 *,**,Ns	3.43 \pm 0.10 ^{no, ns, Ns}

* Significant difference as compared to control (p<0.05)

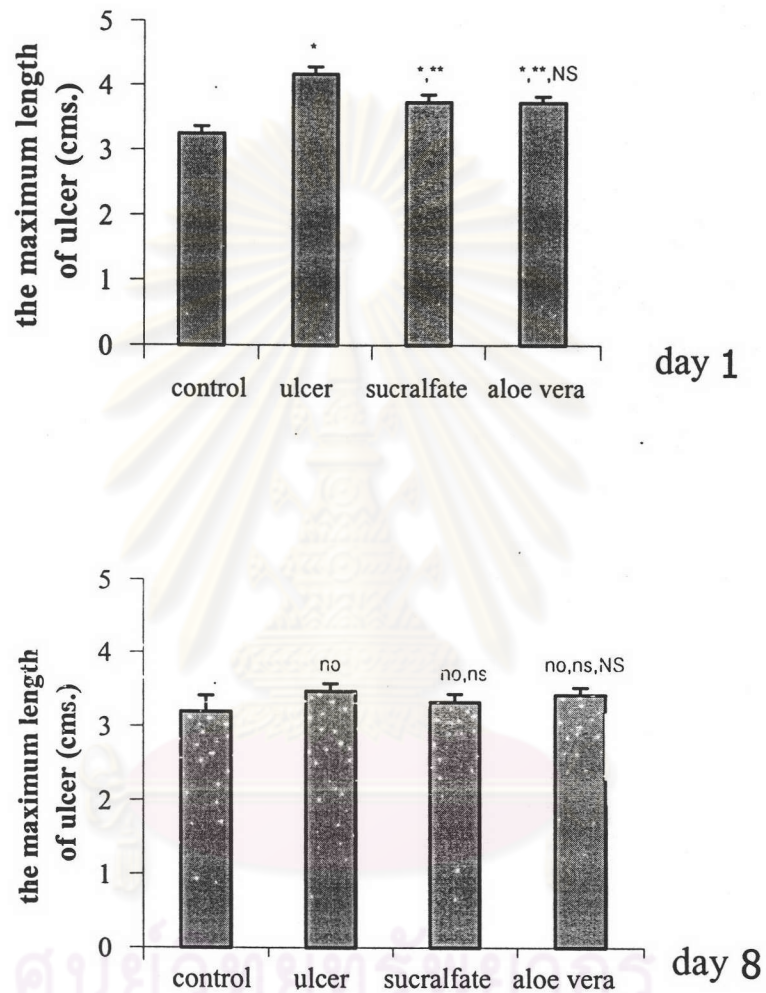
** Significant difference as compared to ulcer (p<0.05)

no No significant difference as compared to control

ns No significant difference as compared to ulcer

NS No significant difference as compared to sucralfate

Figure 4.10 Means \pm SE of the maximum length of gastric ulcer (cms.) in the control, ulcer, ulcer treated with sucralfate, and ulcer treated with *Aloe vera* groups. (Each group n=6)



* Significant difference as compared to control ($p < 0.05$)

** Significant difference as compared to ulcer ($p < 0.05$)

no No significant difference as compared to control

ns No significant difference as compared to ulcer

Ns No significant difference as compared to sucralfate

Table 4.14 The percent curation of gastric ulcer in the ulcer treated with *Aloe vera* group compared to the ulcer treated with sucralfate group on day 1 and day 8 after induced gastric ulcer.

Group	Percent curation of gastric ulcer	
	Day 1	Day 8
Ulcer + sucralfate	11.80	4.31
Ulcer + <i>Aloe vera</i>	15.80	1.47

$$\% \text{ curation} = \frac{\text{Max. length of ulcer}_{(\text{ulcer group})} - \text{Max. length of ulcer}_{(\text{treatment group})}}{\text{Max. length of ulcer}_{(\text{ulcer group})}} \times 100$$

Max. length of ulcer_(ulcer group)

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

(Modified from Mahattanadul, 1996)