RESULTS

Keratitis Group

Patients' characteristics

Age and Sex distribution

Keratitis group comprised 200 patients; 130 males and 70 females with a male:female ratio= 13:7. Mean age of male patients was 36.3±11.3; range 15-54 years, whereas that of female patients was 34.9±11.1; range, 15-53 years, with a non-significant difference (P>0.05) between both sexes as regards age distribution, (Table 9).

Table (9): Keratitis patients' distribution according to gender and age

	Males	Females
Number (%)	130 (65%)	70 (35%)
Age (years)	36.3±11.3 (15-54)	34.9±11.1 (15-53)

Data are presented as number & mean±SD*, percentages & ranges are in parenthesis*

The mean age of patients included in antimicrobial group was 35.4±11; range, 15-54 years, while in honey group was 36.1±11.5; range, 19-51 years, with a non-significant difference (P>0.05) between both groups as regards age, (Fig. 4). Male: female ratio was 62:38 and 69:31 in both groups respectively, with a non-significant difference (X^2=0.65, P>0.05) between both groups, (Table 10, Fig. 5).

Table (10): Keratitis patients' distribution according to gender and age among both groups

	Antimicrobial group (n=100)	Honey group (n=100)
M:F	62:38	69:31
Age (years)	35.4±11 (15-54)	36.1±11.5 (19-51)

Data are presented as ratios & mean±SD*, ranges are in parenthesis*

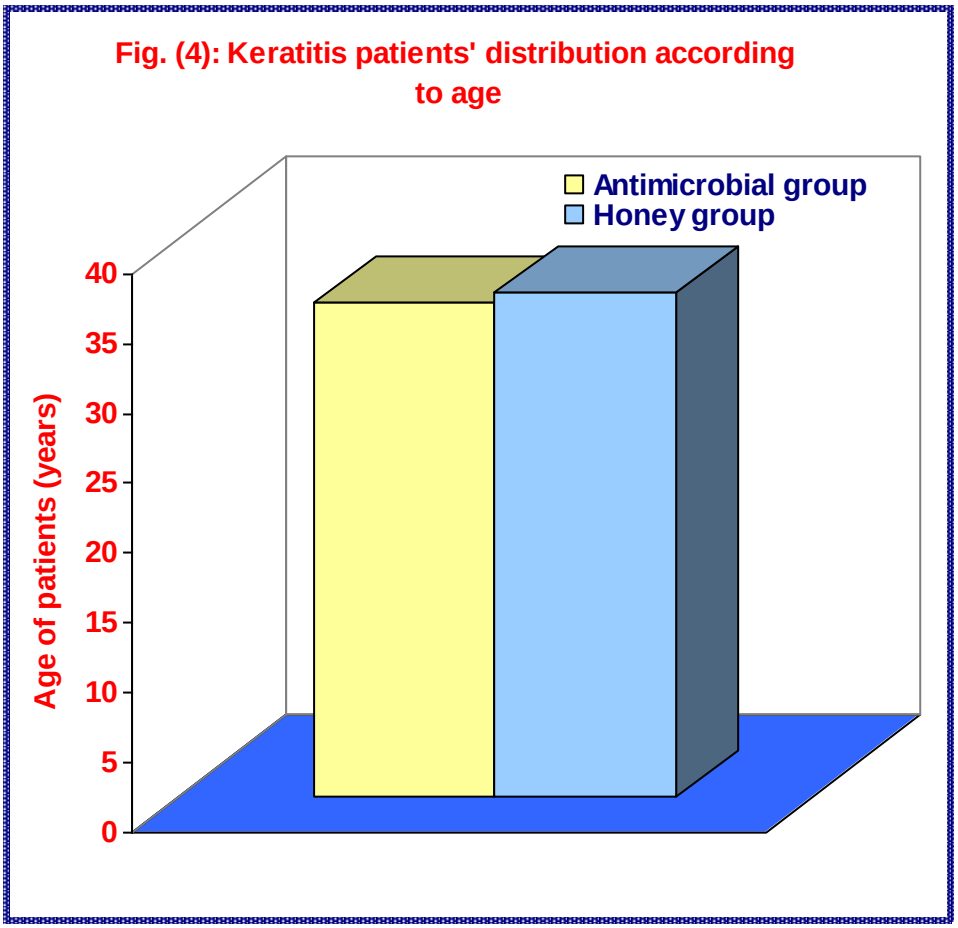


Fig. (4): Keratitis patients' distribution according to age
Antimicrobial group
Honey group
Age of patients (years)
40
35
30
25
20
15
10
5
0

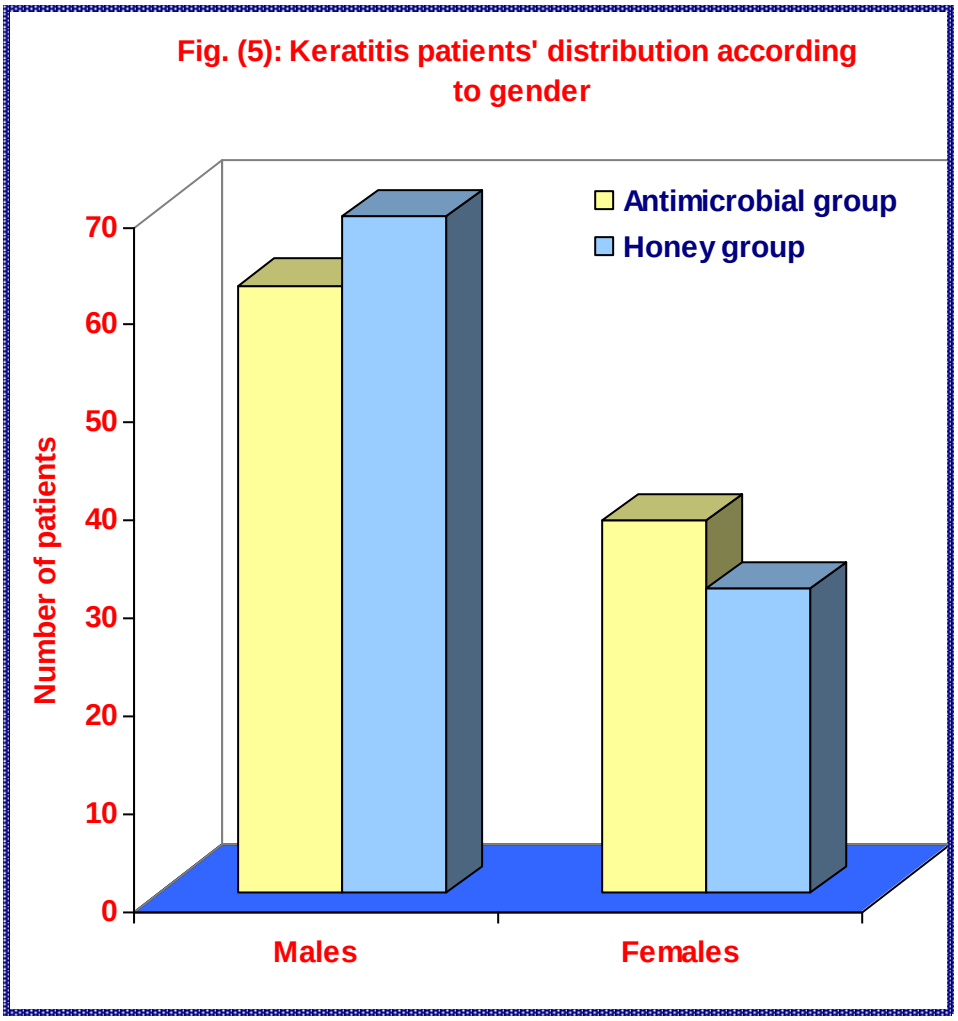


Fig. (5): Keratitis patients' distribution according to gender
Antimicrobial group
Honey group
Number of patients
70
60
50
40
30
20
10
0
Males
Females

Occupation

The majority of patients were farmers; 75 patients (37.5%) with male to female ratio of 2.6:1, 50 patients were manual workers (25%) with male to female ratio of 5.3:1, 26 patients (13%) were students with male to female ratio of 1.4:1 and 22 patients were employees with male to female ratio of 6.3:1. There were 27 female patients (13.5%) were housewives, (Table 11, Fig. 6).

Table (11): Keratitis patients' distribution according to their occupation

Sex / Occupation	Males	Females	Total
Students	15 (6.2%)	11 (4%)	26 (13%)
Employees	19 (14%)	3 (6%)	22 (11%)
Farmer	54 (16%)	21 (4%)	75 (37.5%)
Workers	42 (24%)	8 (8%)	50 (25%)
Housewives	0	27 (18%)	27 (13.5%)
Total	130 (65%)	70 (35%)	200 (100%)

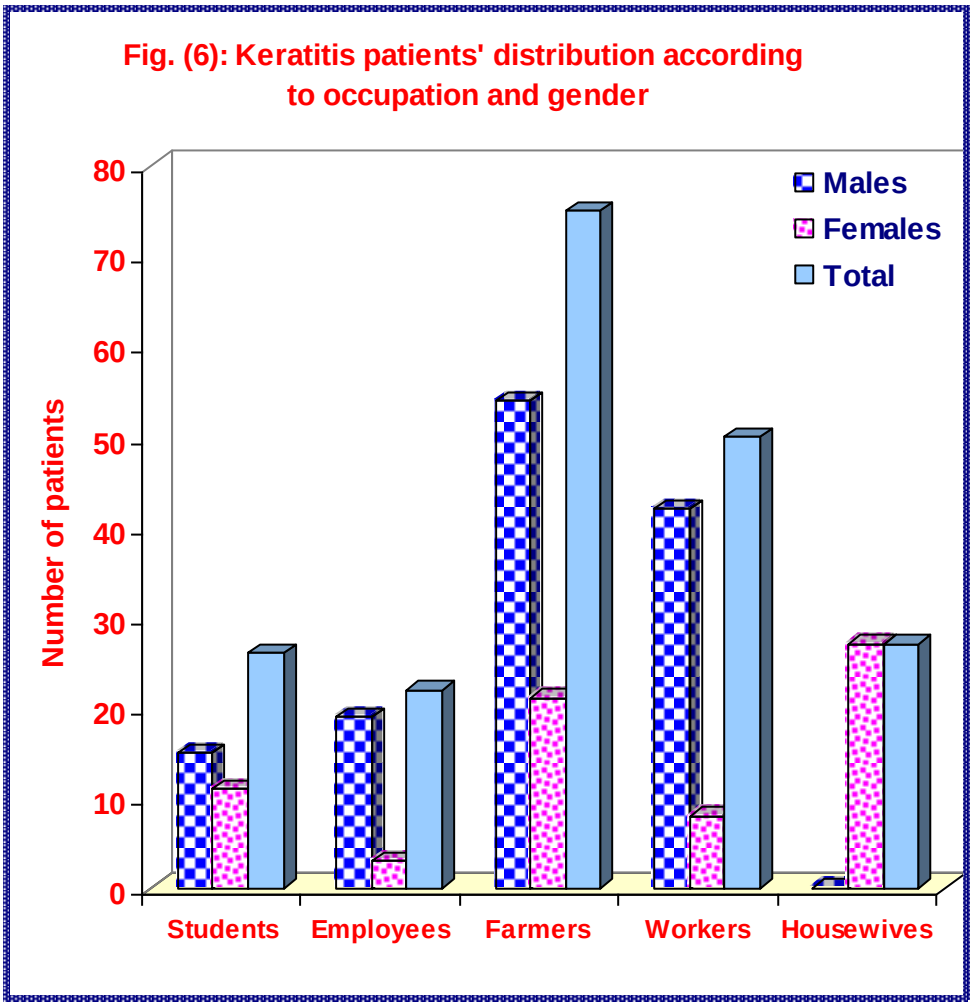


Fig. (6): Keratitis patients' distribution according to occupation and gender
Number of patients
80
70
60
50
40
30
20
10
0
Males
Females
Total
Students
Employees
Farmers
Workers
Housewives

General Diseases

There were 160 patients (80%) free of systemic diseases; while the other 40 patients had variant systemic diseases. Thirteen patients (6.5%) were diabetics, 10 patients (5%) had arthritis, 9 patients (4.5%) had liver disease, 5 patients (2.5%) were corticosteroid users for dermatological disease and 3 patients had renal impairment , (Table 12, Fig. 7). There was a non-significant difference between patients included in antimicrobial and honey groups as regards the frequency of systemic diseases, (X^2=0.36, P>0.05).

Table (12): Keratitis patients' distribution according to the presence of systemic diseases

Group		Antimicrobial	Honey	Total
No systemic diseases (n=160)		81	79	160 (80%)
Systemic diseases (n=40)	**Diabetes mellitus**	6	7	13 (6.5%)
	Arthritis	4	6	10 (5%)
	Liver diseases	5	4	9 (4.5%)
	Corticosteroid user	3	2	5 (2.5%)
	Renal impairment	1	2	3 (1.5%)
Total		100	100	200 (100%)

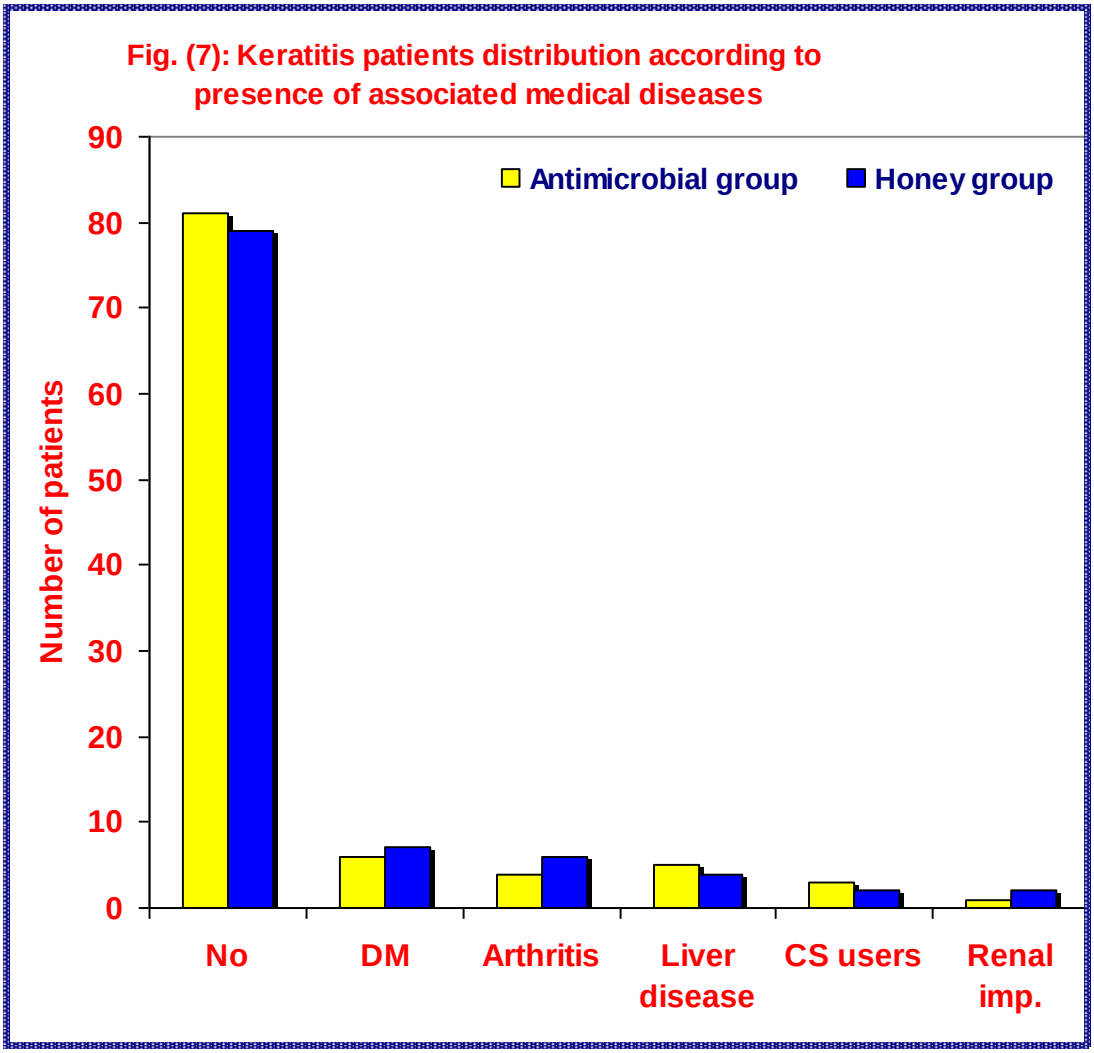


Fig. (7): Keratitis patients distribution according to presence of associated medical diseases
Antimicrobial group
Honey group
Number of patients
90
80
70
60
50
40
30
20
10
0
No
DM
Arthritis
Liver disease
CS users
Renal imp.

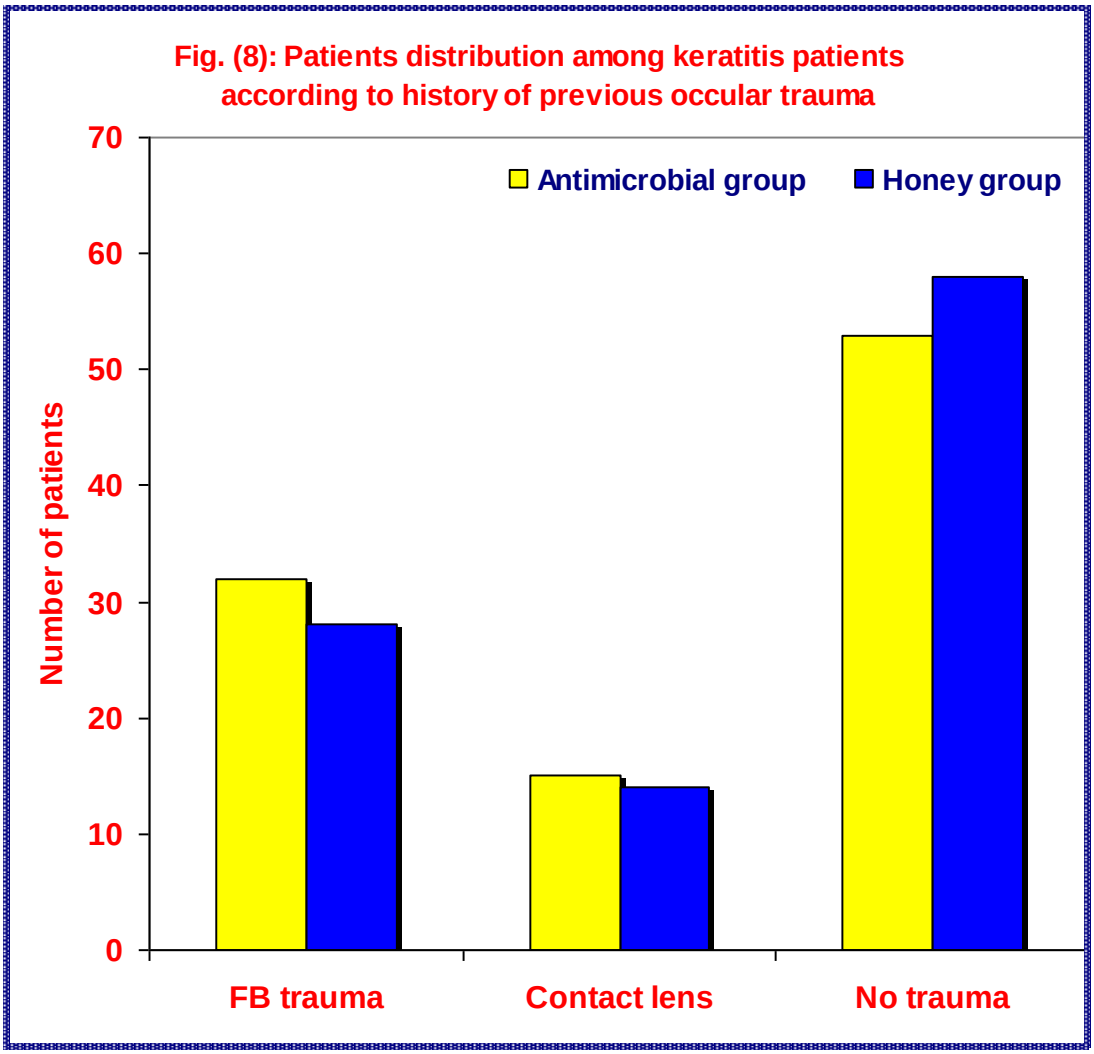
Local trauma

Sixty patients (30%) had foreign body trauma and 29 patients (14.5%) were contact lens wearers. The other 111 patients (55.5%) had no history of previous ocular surgery or trauma, (Table 13, Fig. 8).

Table (13): Keratitis patients' distribution according to the presence of past history of trauma

	Antimicrobial group	Honey group	Total
Foreign body trauma	32	28	60 (30%)
Contact lens wearers	15	14	29 (14.5%)
No history of trauma	53	58	111 (55.5%)
Total	100	100	200 (100%)

Fig. (8): Patients distribution among keratitis patients according to history of previous occular trauma



Ophthalmic Examination

Corneal Opacification

Thirty patients (15%) had past history of previous corneal ulceration that healed but resulted in corneal opacity. There were 17 patients in antimicrobial group and 13 patients in honey group with a non-significant difference between both groups, (X^2=0.234, P>0.05), (Table 14, Fig. 9).

Ten were diabetics, 12 were manual workers exposed to foreign body trauma frequently, 5 patients had hepatic disease and the other 3 patients were maintained on systemic corticosteroid therapy, (Table 15).

Table (14): Keratitis patients' distribution according to the presence of corneal opacity

	Antimicrobial group	Honey group	Total
No corneal opacity	83	87	170 (85%)
Corneal opacity	17	13	30 (15%)
Total	100	100	200 (100%)

Table (15): Distribution of patients with corneal opacity according to the causative factor

	Antimicrobial group	Honey group	Total
Diabetics	6	4	10 (5%)
Foreign body trauma	6	6	12 (6%)
Hepatic disease	3	2	5 (2.5%)
Systemic steroid therapy	2	1	3 (1.5%)
Total	17	13	30 (15%)

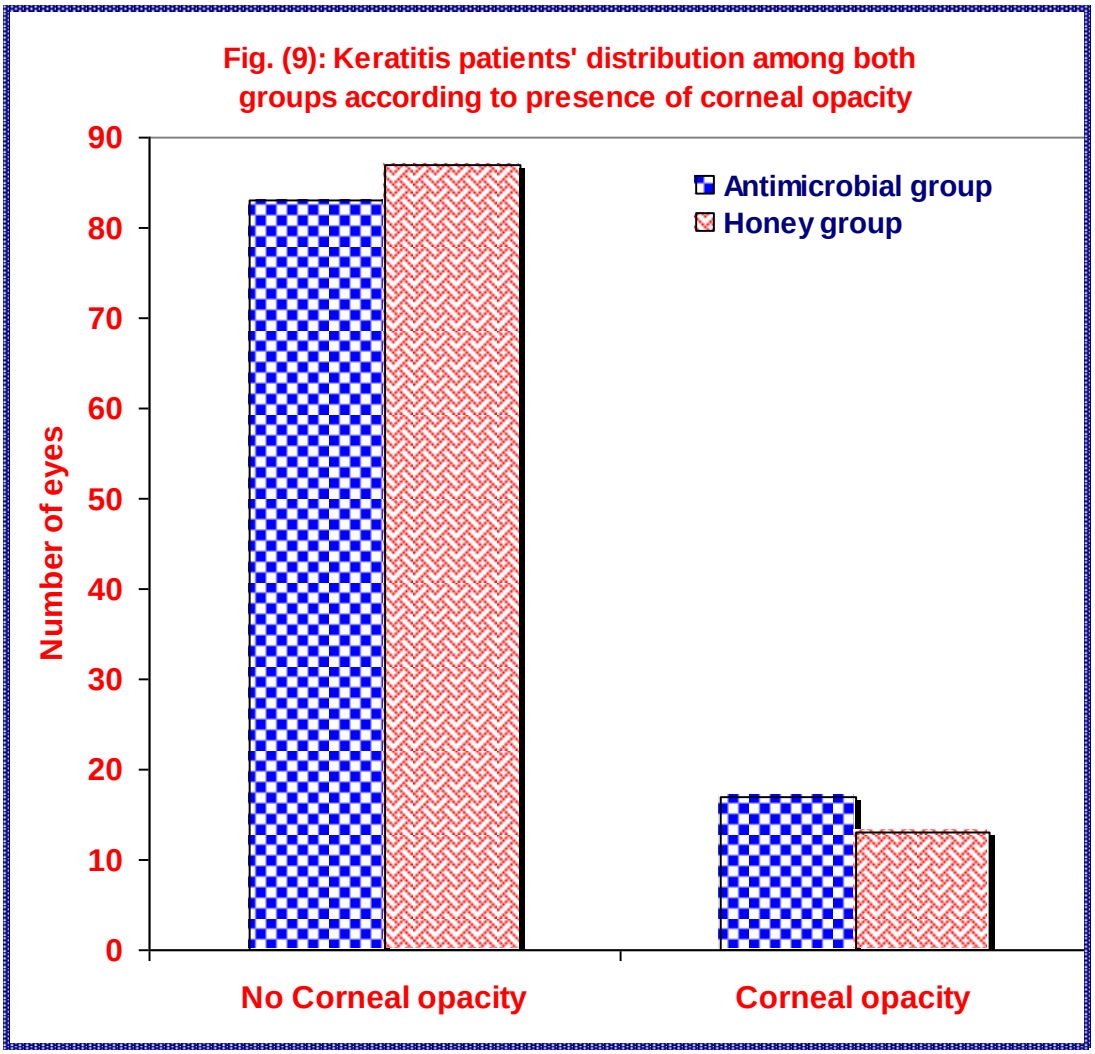


Fig. (9): Keratitis patients' distribution among both groups according to presence of corneal opacity
Number of eyes
90
80
70
60
50
40
30
20
10
0
Antimicrobial group
Honey group
No Corneal opacity
Corneal opacity

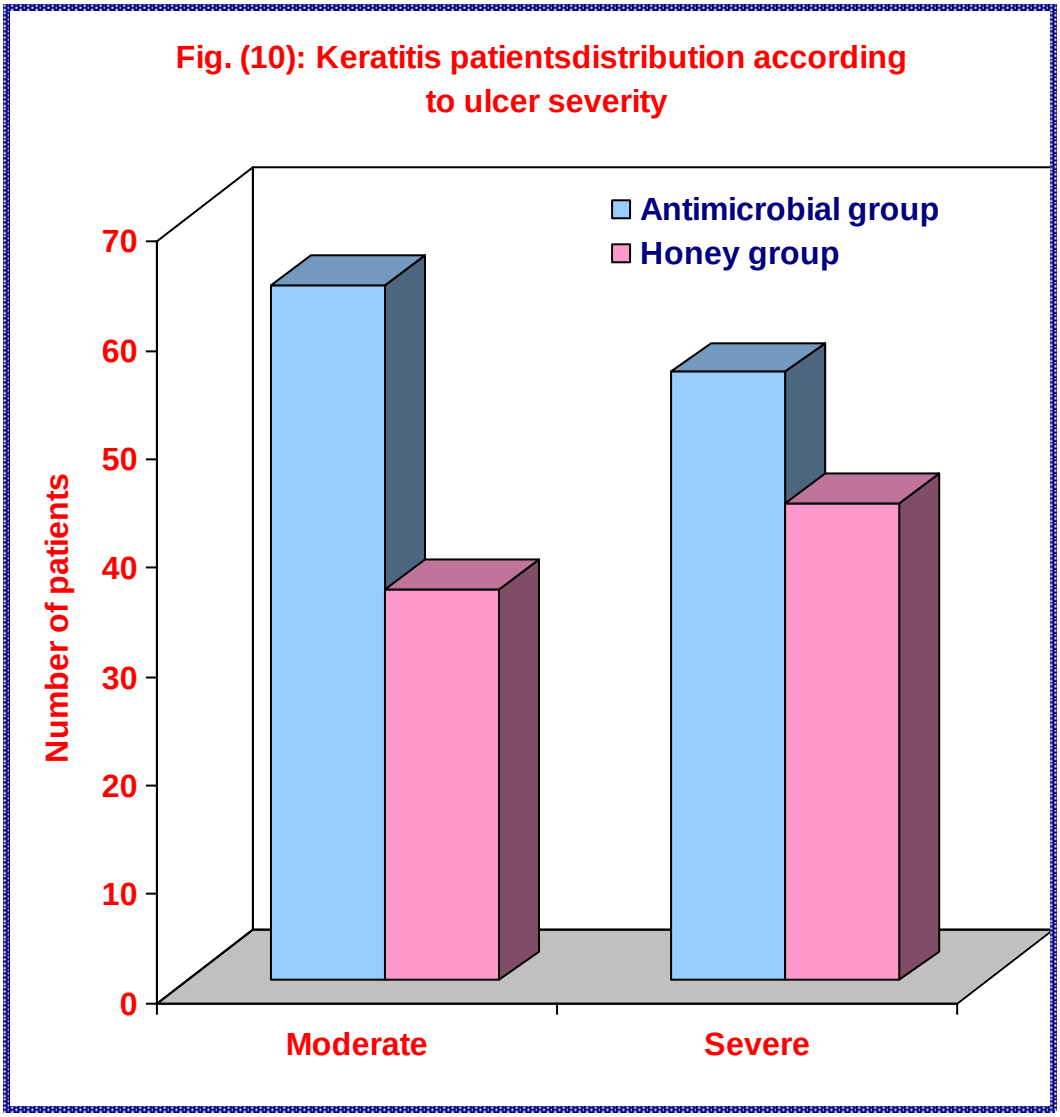
Ulcer severity

There were 120 eyes (60%) with moderate ulcer; 64 in antimicrobial group and 56 in honey group and 80 eyes had severe ulcer; 36 in antimicrobial group and 44 in honey group, (Table 16, Fig. 10). There was a non-significant difference between both groups as regards the frequency of ulcers of the two types, (X^2=0.42, P>0.05).

Table (16): Ulcers' distribution according to ulcer severity

	Antimicrobial group	Honey group	Total
Moderate Ulcer	64	56	120 (60%)
Severe Ulcer	36	44	80 (40%)
Total	100	100	200 (100%)

Fig. (10): Keratitis patientsdistribution according to ulcer severity



Results of Laboratory Studies

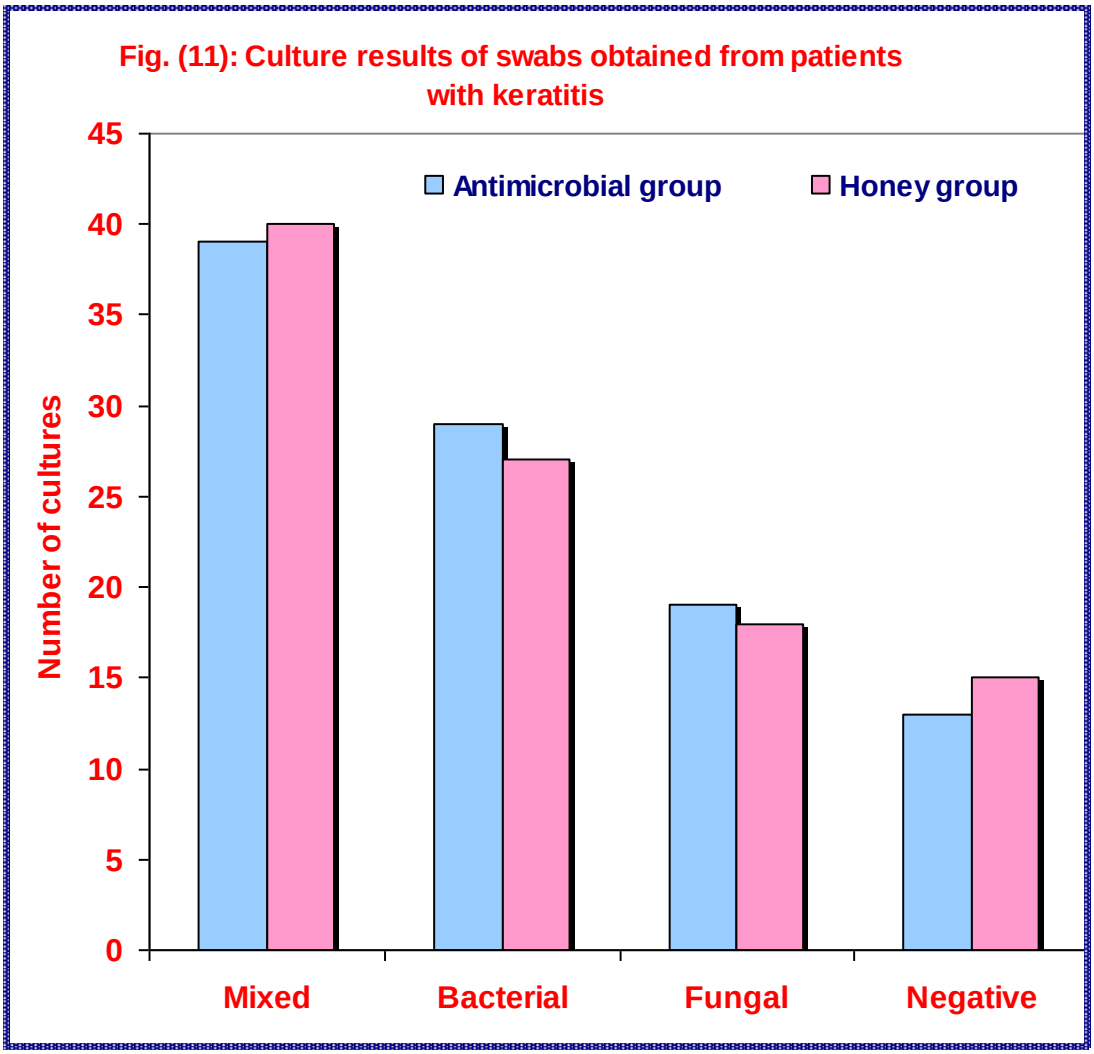
A) Culture results

- No growth either on bacterial or fungal culture media was reported in 28 specimens (14%). The patients gave these specimen were examined clinically and stained for viral infection and all proved to viral ulcers.
- Seventy-nine specimens gave growth on both bacterial and fungal culture media (Mixed infection).
- Fifty-sex specimens gave growth on bacterial culture media only (Pure bacterial infection).
- Thirty-seven specimens gave growth only on fungal culture media (Pure fungal infection), (Table 17, Fig. 11).
- There was a non-significant difference between antimicrobial and honey groups as regards the frequency of result of culture examination, (X^2=0.9, p>0.05).

Table (17): Culture results of specimens obtained from keratitis patients

	Antimicrobial group	Honey group	Total
Mixed (bacterial & fungal)	39	40	79 (39.5%)
Bacteria	29	27	56 (28%)
Fungi	19	18	37 (18.5%)
Negative	13	15	28 (14%)
Total	100	100	200 (100%)

Fig. (11): Culture results of swabs obtained from patients with keratitis

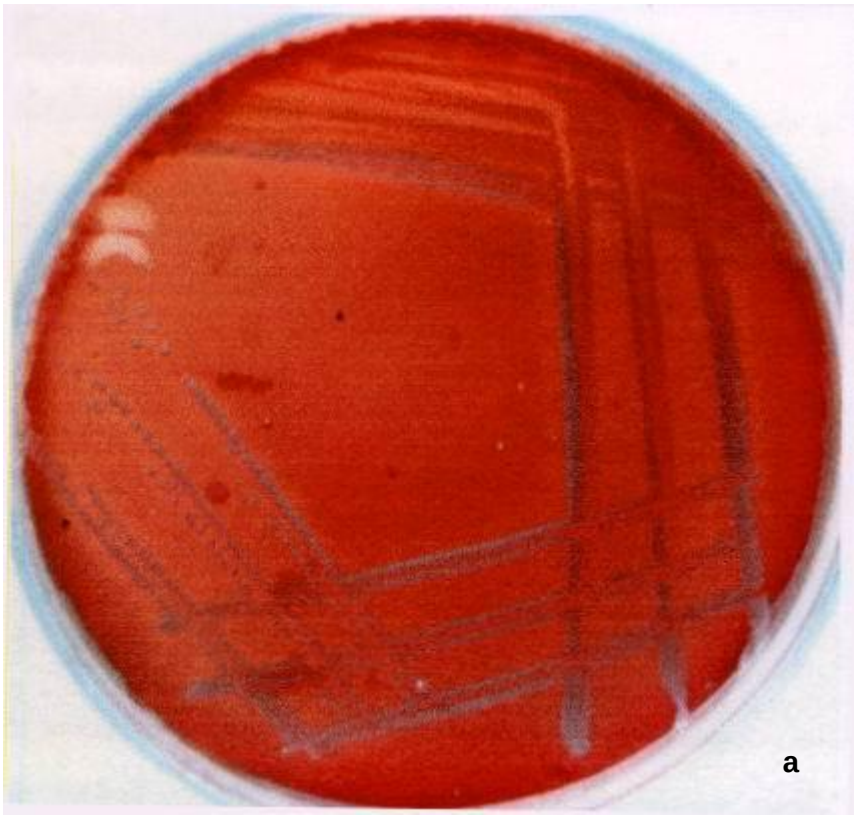


B) Identification of Infecting Pathogens

- Identification of infecting organisms defined variant types of bacteria in 135 specimens; 56 pure and 79 mixed, (Table 18).
  - *Staph. aureus*, (Fig. 12 a&b) was defined in 34 specimen; 13 pure and 31 mixed bacterial infections
  - *Staph. epidermosa* was defined in 32 specimens; 12 pure and 20 mixed bacterial infections
  - *Ps. Aeruginosa* (Fig. 13 a-d) was defined in 27 specimens; 10 pure and 17 mixed bacterial infections.
  - *Esch. Coli* (Fig. 14 a-c) was defined in 9 specimens; 5 pure and 4 mixed bacterial infections
  - *Proteus* (Fig. 15 a&b) was defined in 3 specimens; 2 pure and one mixed bacterial infections.
  - *Streptococci* (Fig 16) was defined in 7 specimens; 4 pure and 3 mixed bacterial infections.
  - *Micrococcus luteus* was defined in 13 specimens; 6 pure and 7 mixed bacterial infections
  - *Bacillus cerus* was defined in 10 specimens; 4 pure and 6 mixed bacterial infections.
- Identification of infecting organisms defined variant types of fungi in 116 specimens; 37 pure and 79 mixed, (Table 18).
  - Fungal infection was caused by *Candida albicans* (Fig. 17 a&b) in 14 pure fungal infections and 32 mixed infection
  - *Aspergillus fumigatus* (Fig. 18 a&b) was defined in 9 pure fungal infections and 18 mixed infection,
  - *Fusarium solani* (Fig. 19 a&b) was defined in 6 pure fungal infections and 13 mixed infection and
  - *Aspergillus niger* (Fig. 20 a&b) was defined in 5 pure fungal infections and 9 mixed infection and
  - *Pencillium species* in 3 pure fungal infections and 7 mixed infection.

Table (18): Infective pathogens detected in the corneal smears

	Pure infection	Mixed infection	Total
Staph. Aureus	13	21	34
Pseudomonas aeruginosa	10	17	27
Staph. Epidermosa	12	20	32
Esch. coli	5	4	9
Proteus	2	1	3
Streptococci	4	3	7
Micrococcus luteus	6	7	13
Bacillus cerus	4	6	10
C. albicans	14	32	46
Aspergillus fumigatus	9	18	27
Fusarium solani	6	13	19
Aspergillus niger	5	9	14
Penicillium species	3	7	10



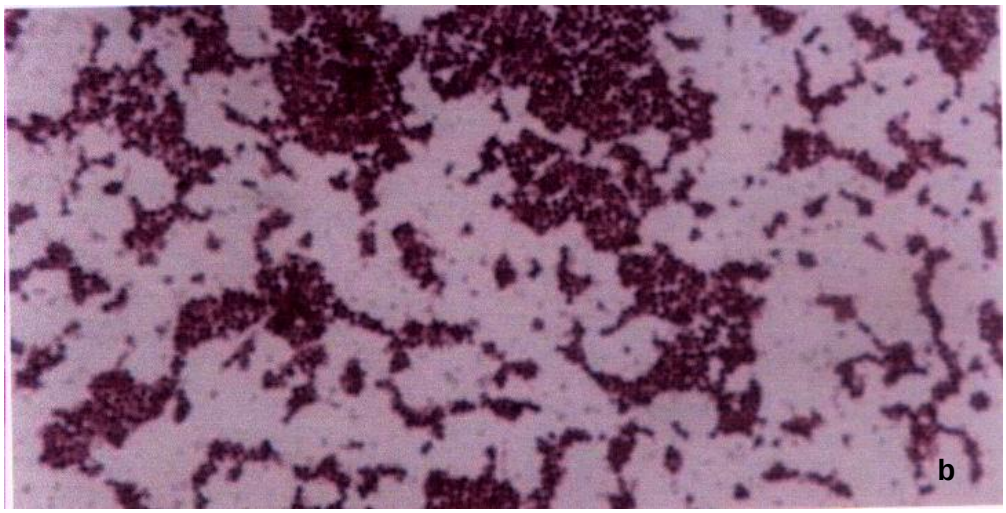


Fig. (12): shows complete hemolysis on blood agar plate (a) and Gram staining of inoculums showed Gram positive cocci (b) both diagnose *staph. aureus* infection

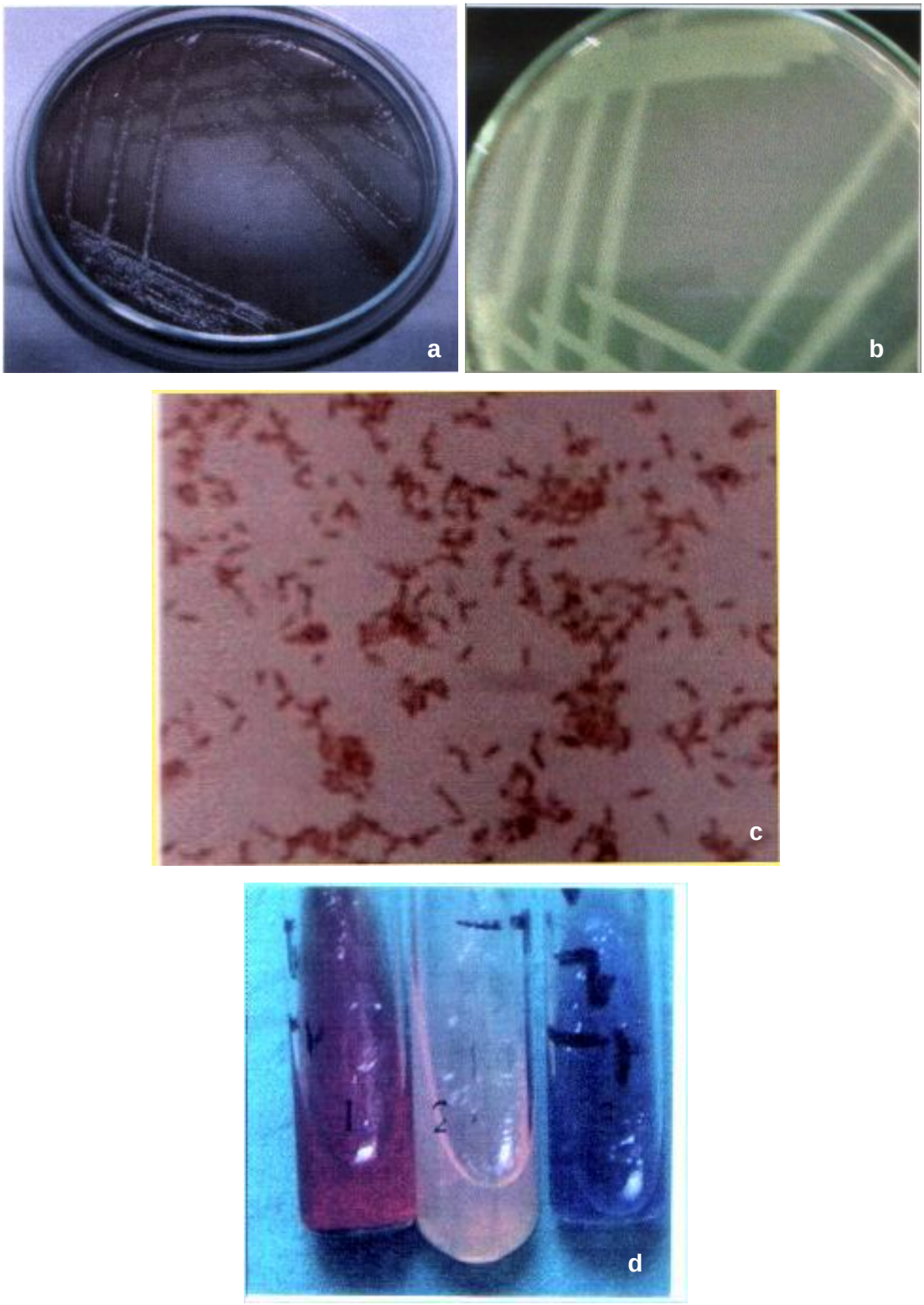


Fig. (13): shows bacteriological diagnostic tests for *Ps. Aeruginosa* infection

a. Lactose non-fermenter
b. Green exo-pigments on nutrient agar.
c. Gram negative bacilli on microscopic examination
d. Biochemical tests: triple sugar non-fermenter (tube 1), urease test negative (tube 2) & citrate test positive (tube 3).

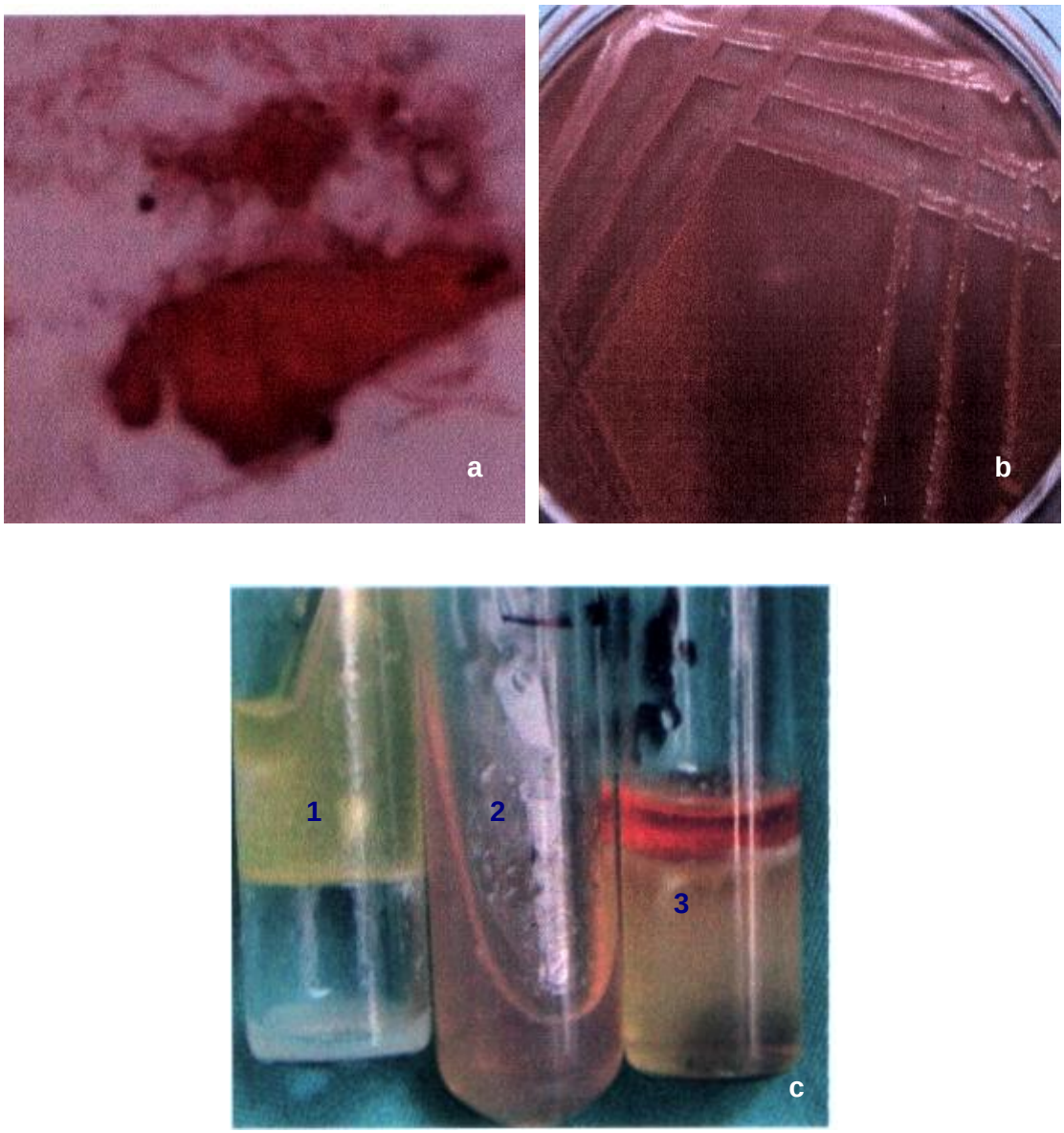


Fig. (14): shows bacteriological diagnostic tests for mixed *E. coli and Candida* infection

a. Direct Gram smear shows Gram negative bacilli and stained mucosa
b. Lactose fermenter on Mac Conkey
c. Biochemical tests:

   Tube (1): triple sugar test showing yellow slant, yellow butt & gas at bottom.

   Tube (2): urease test negative

   Tube (3): SIM test showing positive indole test (red ring), motile organism (turbid media) & no sulphid production

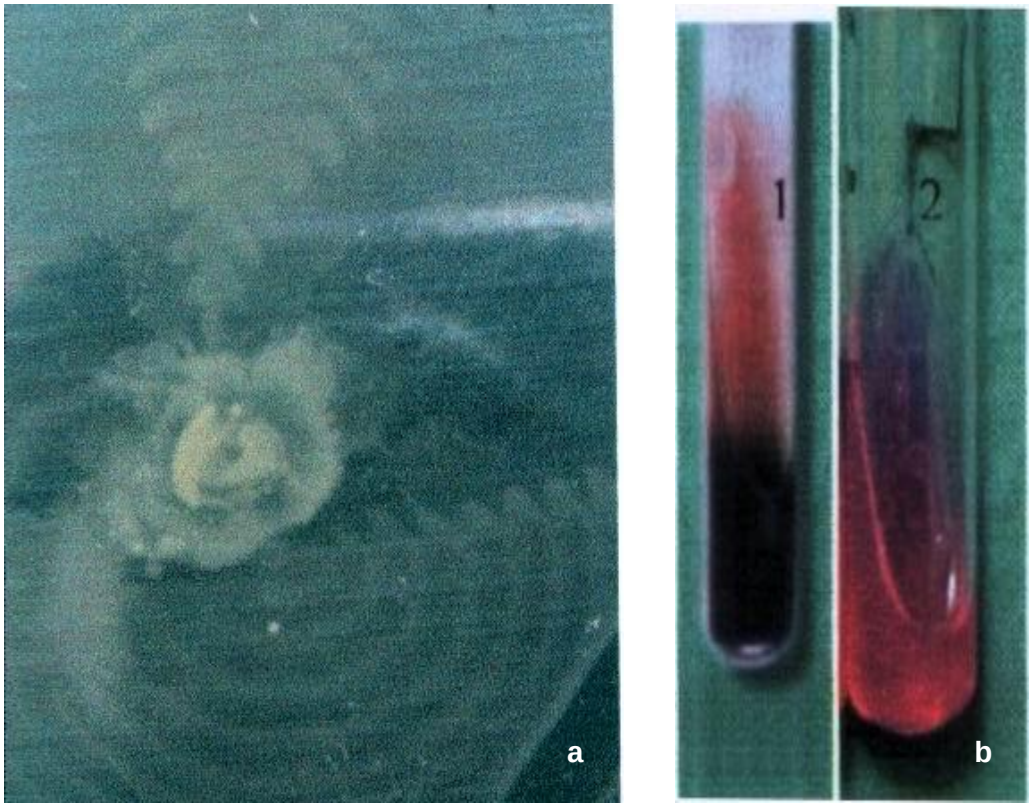


Fig. (15): shows bacteriological diagnostic tests for *Proteus* infection

a. Swarming colony of proteus on nutrient agar

b. Biochemical tests:

Tube (1): triple sugar test showing alkaline red slant & black butt (H_2S producer)

Tube (2): urease test positive

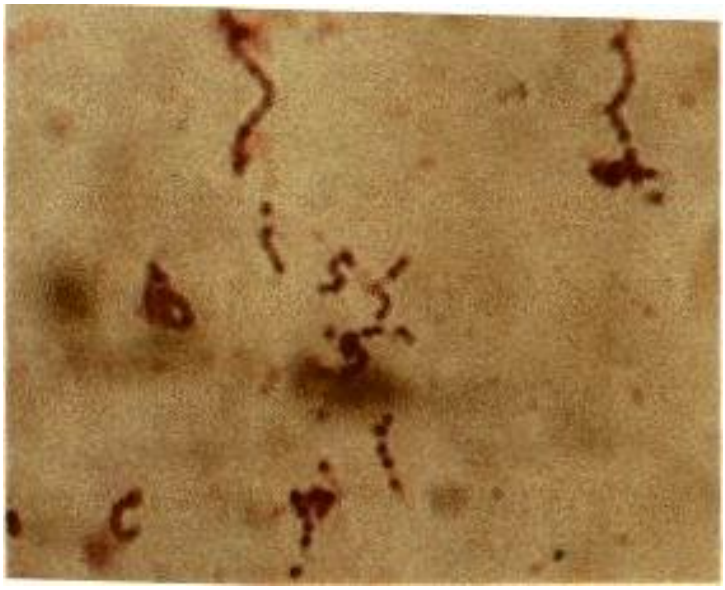
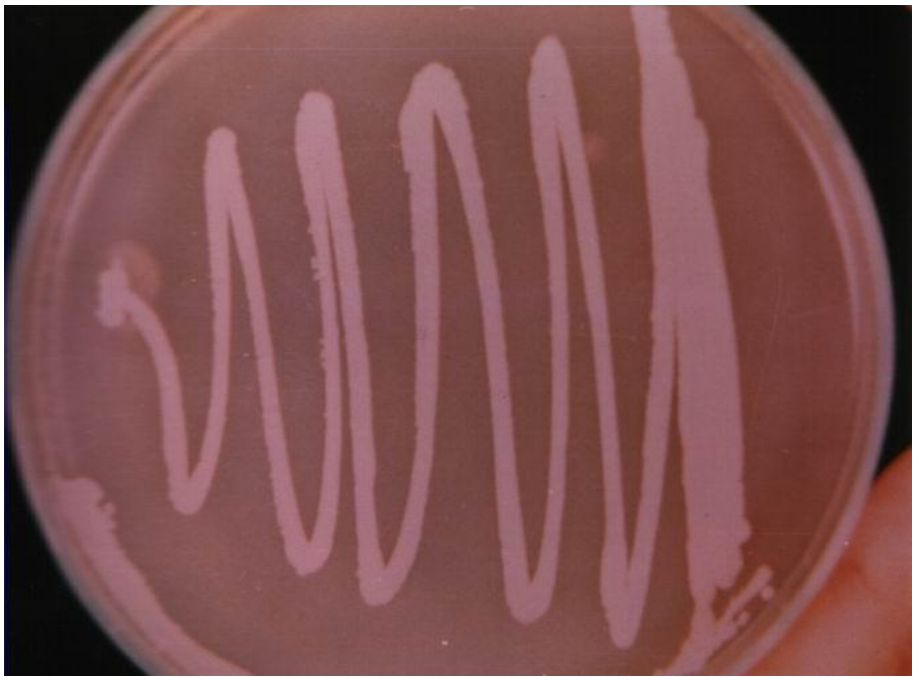


Fig. (16): shows Gram positive cocci; *Streptococci*



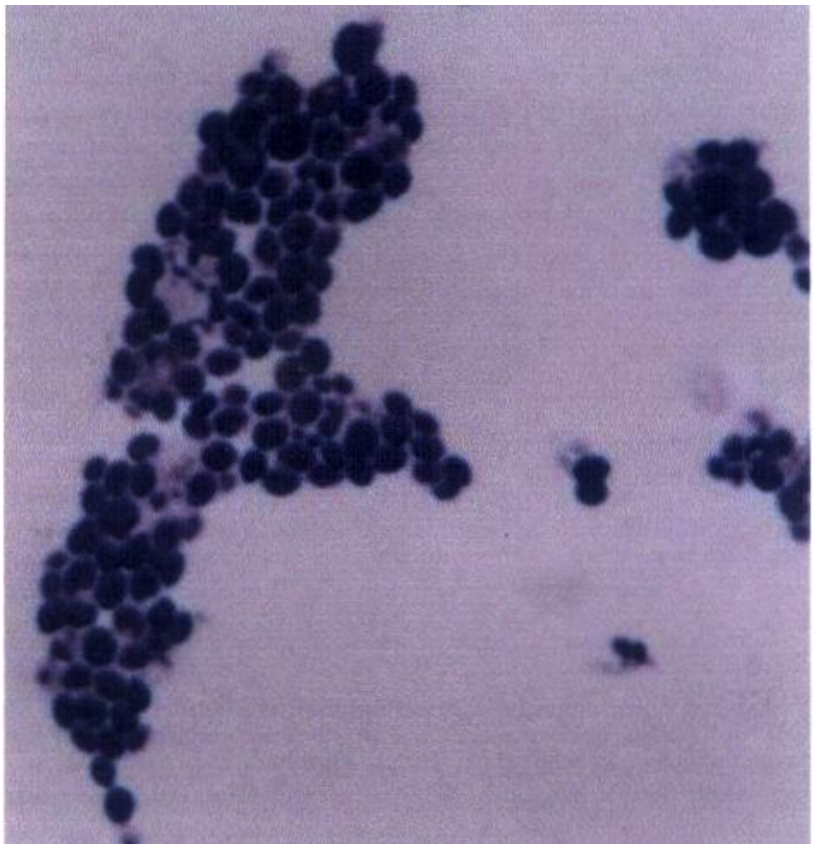


Fig. (17): shows diagnostic tests for *Candida* infection

a. Growth of Candida on Sabouraud's agar

b. Microscopic appearance of Gram stained Candida (x1000).

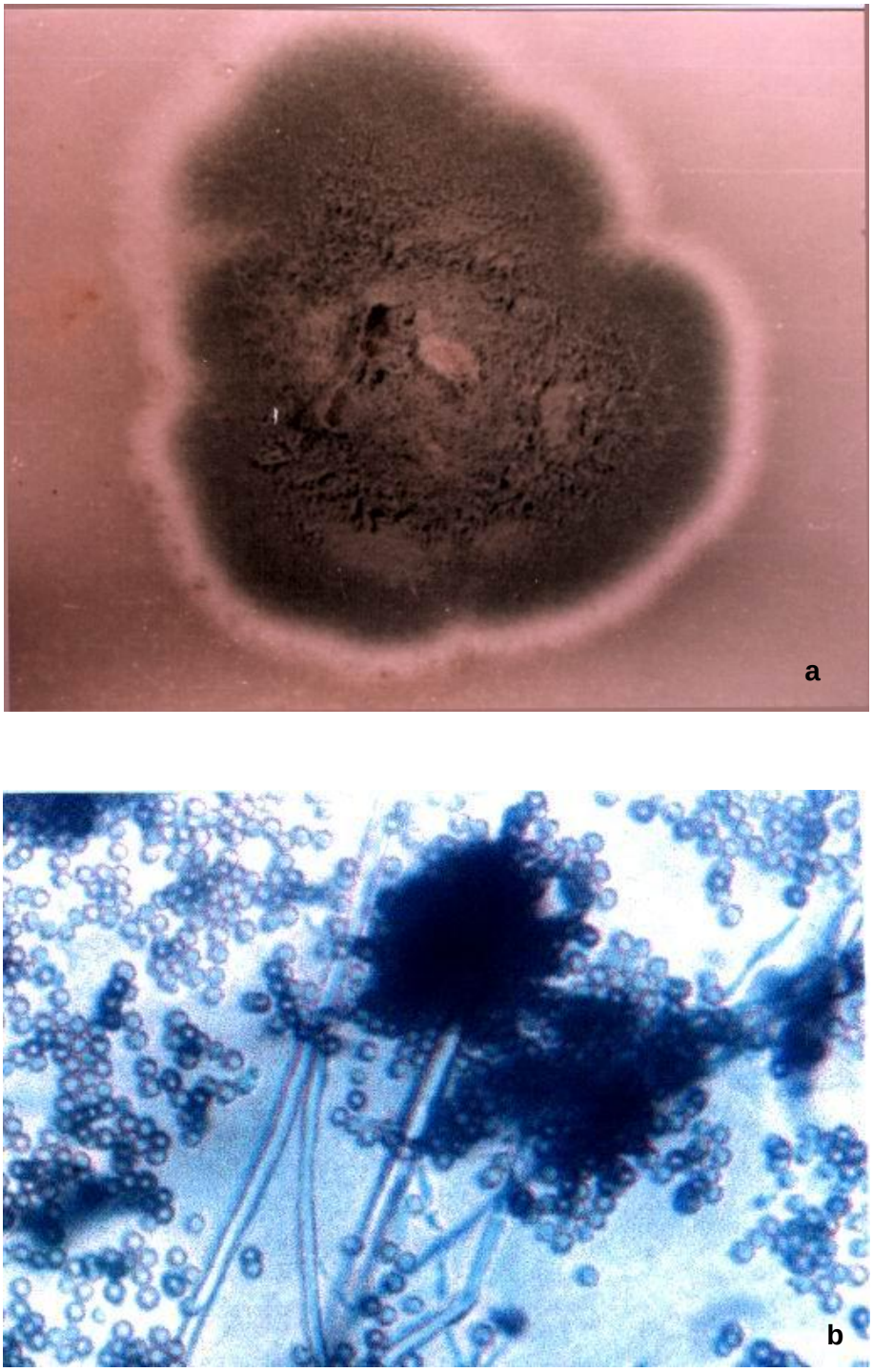
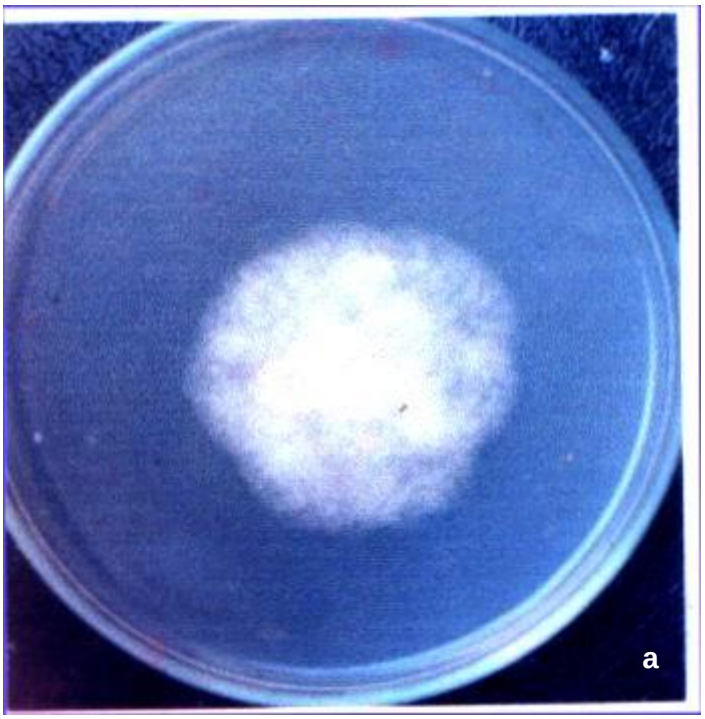


Fig. (18): shows diagnostic tests for *Aspergillus fumigatous* infection

c. Growth of *Asp. fumigatous* on Sabouraud's agar

d. Microscopic appearance of *Asp fumigatous* using a drop of distilled water (x400) showing characteristic numerous and smooth spores



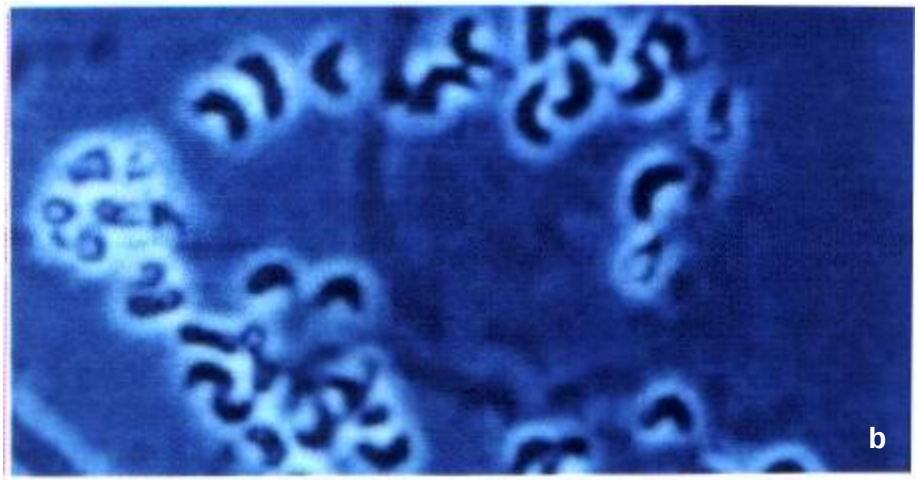


Fig. (19): shows diagnostic tests for *Fusarium solani* infection

a. Growth of *F. solani* on Sabouraud's agar

b. Microscopic appearance of Asp fumigatous using a drop of methylene blue 10% (x400).

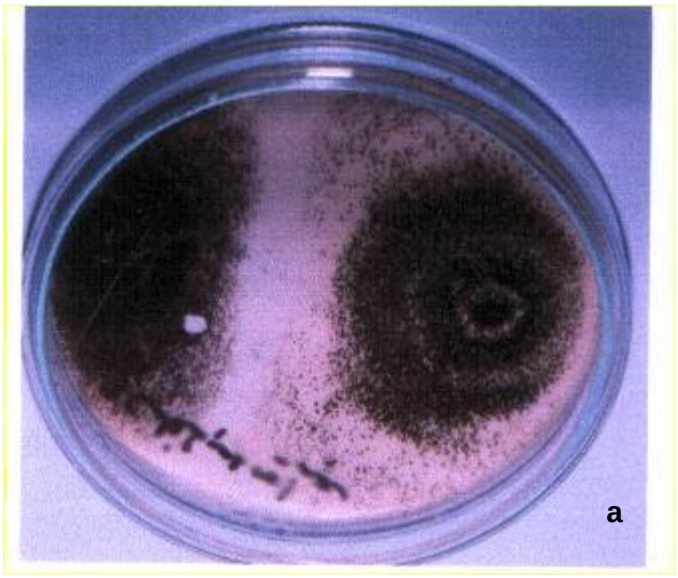


Fig. (20): shows diagnostic tests for *Aspergillus niger* infection

a. Growth of *Aspergillus niger* on Sabouraud's agar

b. Microscopic appearance of *Asp. niger* using a drop of distilled water (x400).

C) Sensitivity Tests

- Honey gave rapid antimicrobial activity evaluated by growth inhibition zones that non-significantly different from that achieved with ciprofloxacin.
  - High activity with inhibition zone more than 20 mm was reported against growth *Staph. Epidermosa*, (Fig. 21), *Micrococcus luteus*, (Fig. 22), and *Ps. Aeruginosa*, (Fig. 23).
  - Moderate activity with inhibition zone of 10-20 mm was reported against growth of *Bacillus cerus*, (Fig. 24) and *Staph. Aureus*, (Fig. 25).
  - The percentages of inhibition of yeast and Asp fumigatus growth were 66.6% and 75%, respectively in comparison to clotrimazole 1% that showed percentage of inhibition of 86% and 95% on fungal growth, (Table 19).

Table (19): Results of in-vitro antimicrobial effect of honey in comparison to appropriate antimicrobial drug

	Honey	Control	
		Ciprofloxacin	Clotrimazole 1%
Staph. Epidermosa	+++	+++	
Staph. Aureus	++	++	
Pseudomonas aeruginosa	+++	+	
Micrococcus luteus	+++	+++	
Bacillus cerus	++	++	
Yeast	66.6%		86%
Aspergillus fumigatus	75%		95%

Fig. (21): Staph. *Epidermosa*

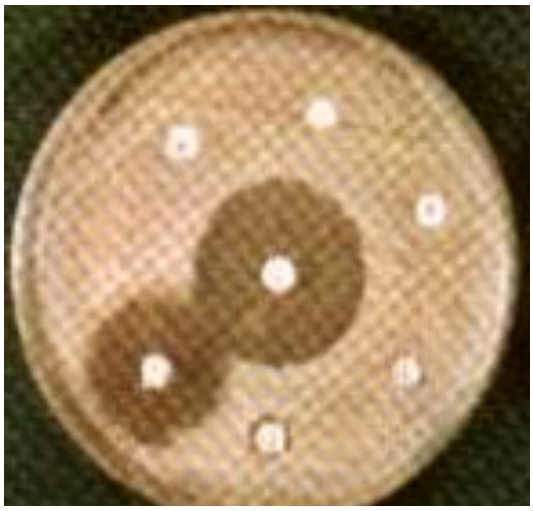


Fig. (22): *Micrococcus luteus*

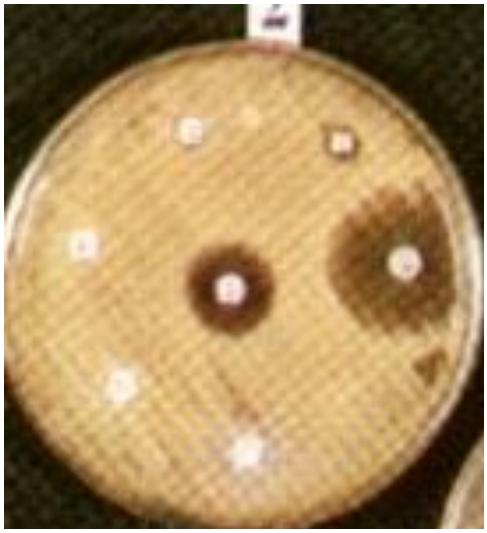


Fig. (23): *Ps. Aeruginosa*

Fig. (24): *Bacillus cerus*

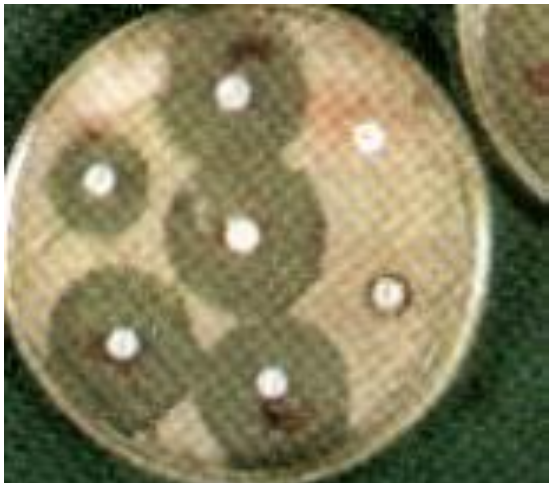
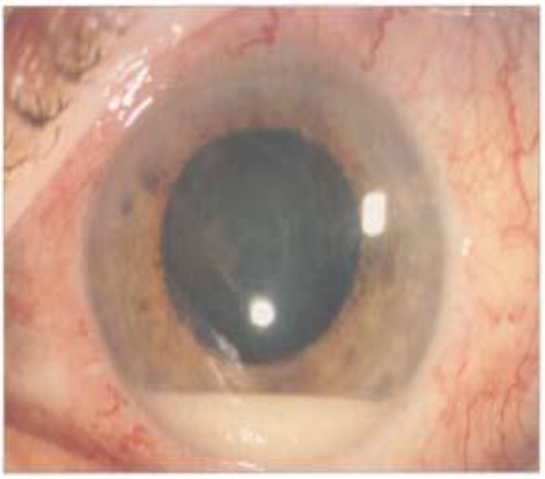
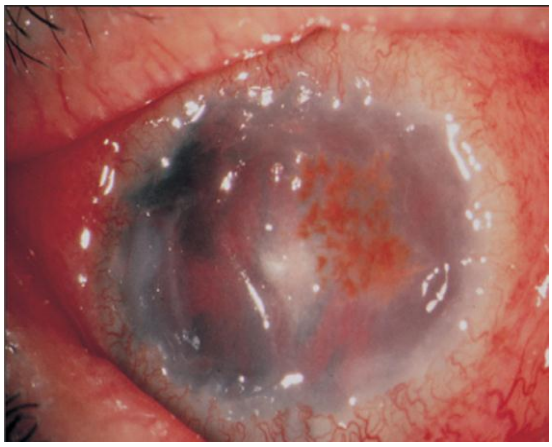


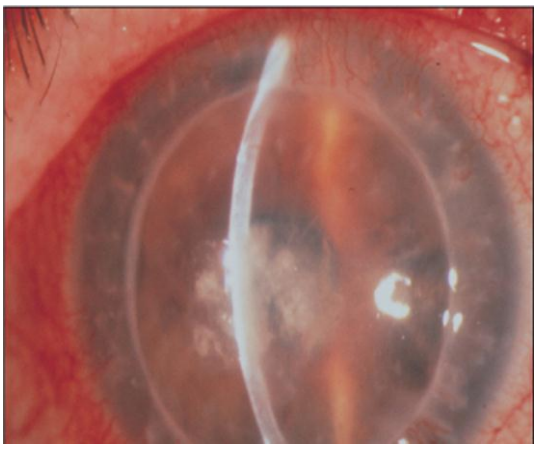
Fig. (25): *Staph. Aureus*

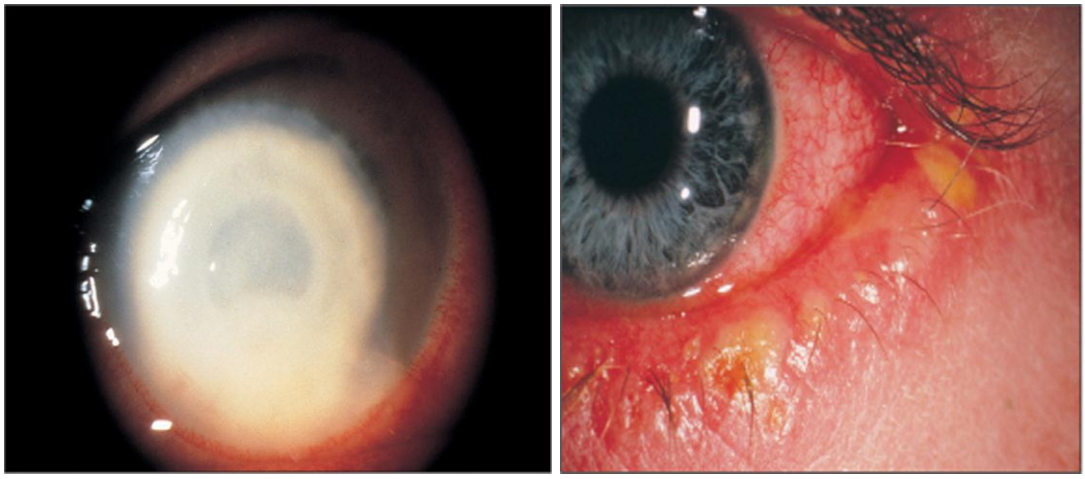
***Ophthalmic Diagnosis* (Case Presentation)**

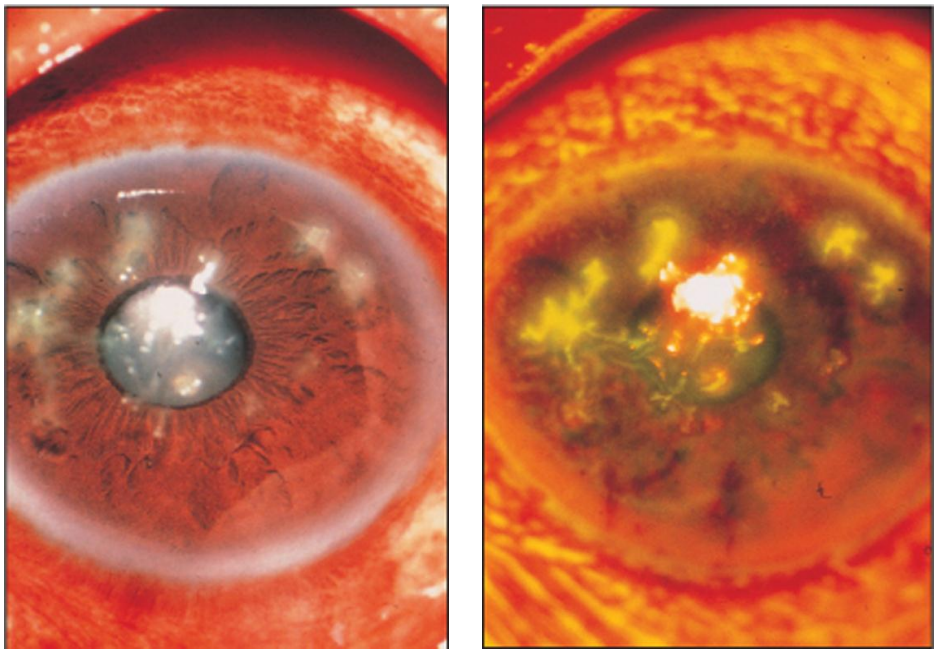
- Typical microbial keratitis: There was accumulation of inflammatory cells at the dependent part of the anterior chamber of the eye (hypopyon) and mid-corneal defect, (Fig. 26).
- Hypopyon: There are layered inflammatory cells in the anterior chamber of the eye, (Fig. 27).
- Streptococcal bacterial keratitis with infiltration of the central cornea, (Fig. 28).
- Infectious crystalline keratopathy caused by Streptococcus viridans, (Fig. 29).
- Pseudomonas infection of the cornea, with liquefying necrosis, advanced central thinning, and hypopyon formation, (Fig. 30).
- Viral infection:
  a. Vesicles of the eyelid caused by herpes simplex virus primary infection, (Fig. 31).
  b. Dendritic lesions of recurrent herpes simplex epithelial disease (Fig. 32).
  c. Slit-lamp appearance of:
     - Active necrotizing stromal disease of recurrent herpes simplex infection with central corneal infiltration and thininng, inflammation and hypopyon formation, (Fig. 33a).
     - Significant central corneal scarring following necrotizing stromal disease caused by recurrent herpes simplex virus infection, (Fig. 33b).
- Fungal infection:
  a. Fungal keratitis: The corneal surface looks rough with several satellite lesions seen at the periphery on the left side of the cornea, (Fig. 34).
  b. Slit-lamp appearance of feathery stromal infiltrates typical of fungal keratitis, (Fig. 35).
- Contact lens keratopathy:
  a. Contact lens acute red eye, (Fig. 36).
  b. Intraepithelial infiltration of the cornea by Pseudomonas organisms in a hydrophilic contact lens wearer, (Fig. 37).

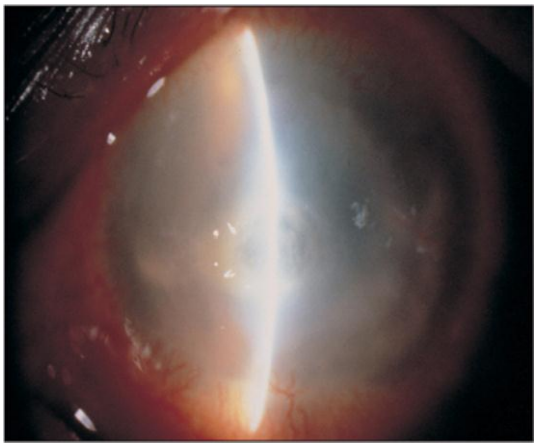


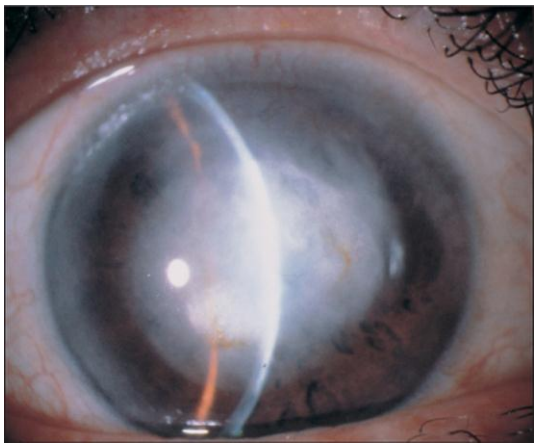


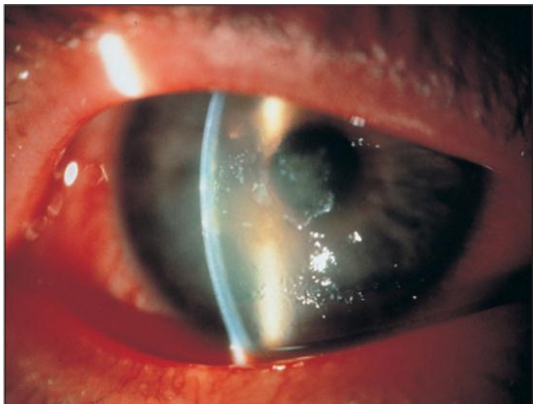


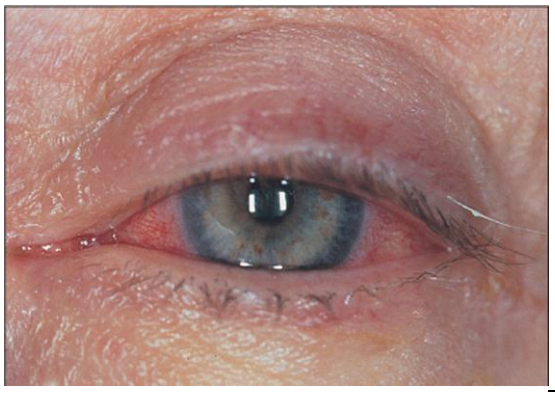


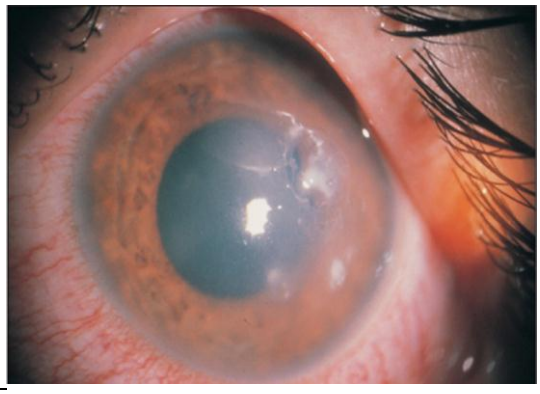












Clinical Outcome

A) Pain

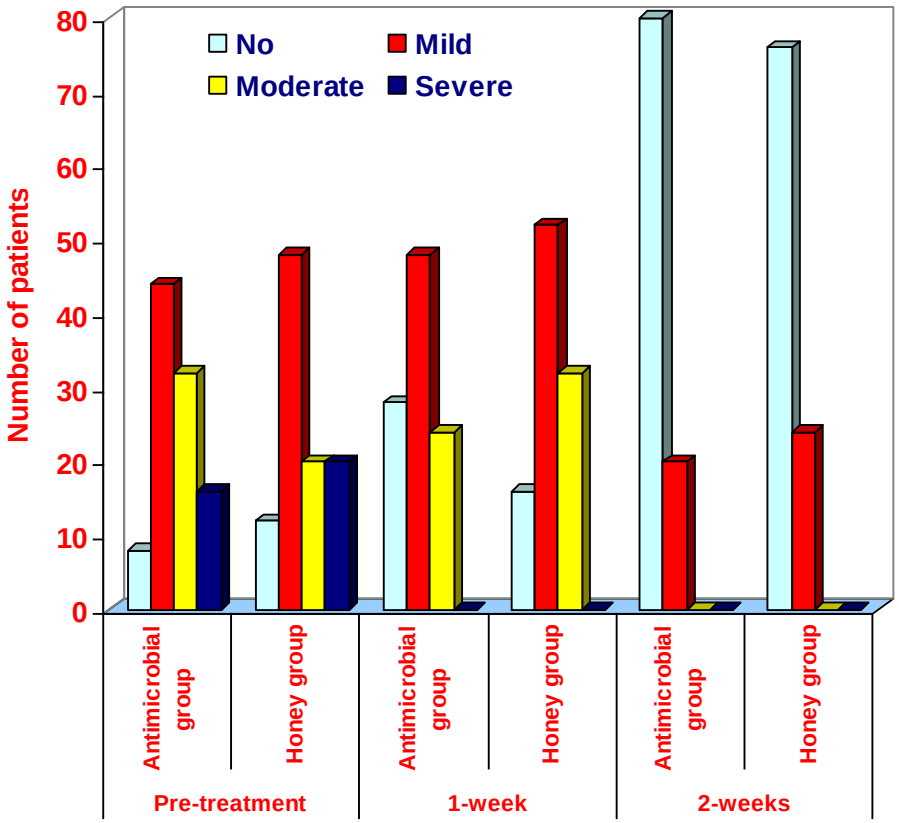
- Both lines of treatment could achieve dramatic pain relief with a significant increase in number of patients with less pain-grade at 1-week and 2-weeks in comparison to pretreatment pain grade and a significant increase in number of patients at 2-weeks in comparison to those reported at 1-week, but with non-significant difference between frequency of patients according to pain grade between both groups (Table 20, Fig. 38).

Table (20): Pain grade determined at 1-week and 2-weeks in comparison to pre-treatment pain grade in both groups

Time	Pre-treat		1-w		2-w	
Pain grade	Antimicrobial group	Honey group	Antimicrobial group	Honey group	Antimicrobial group	Honey group
No	8	12	28	16	80	76
Mild	44	48	48	52	20	24
Moderate	32	20	24	32	0	0
Severe	16	20	0	0	0	0
P_1			<0.01	<0.01	<0.001	<0.001
P_2					<0.001	<0.001
P_3	>0.05		>0.05		>0.05	

P_1 : significant versus pre-treatment
P_2 : significant versus 1-week
P_3 : significant versus Honey group

Fig. (38): Patients' distribution according to pain sensation grade in keratitis patients at one & two-weeks of treatment compared to pre-treatment grade



B) <u>Foreign body sensation</u>

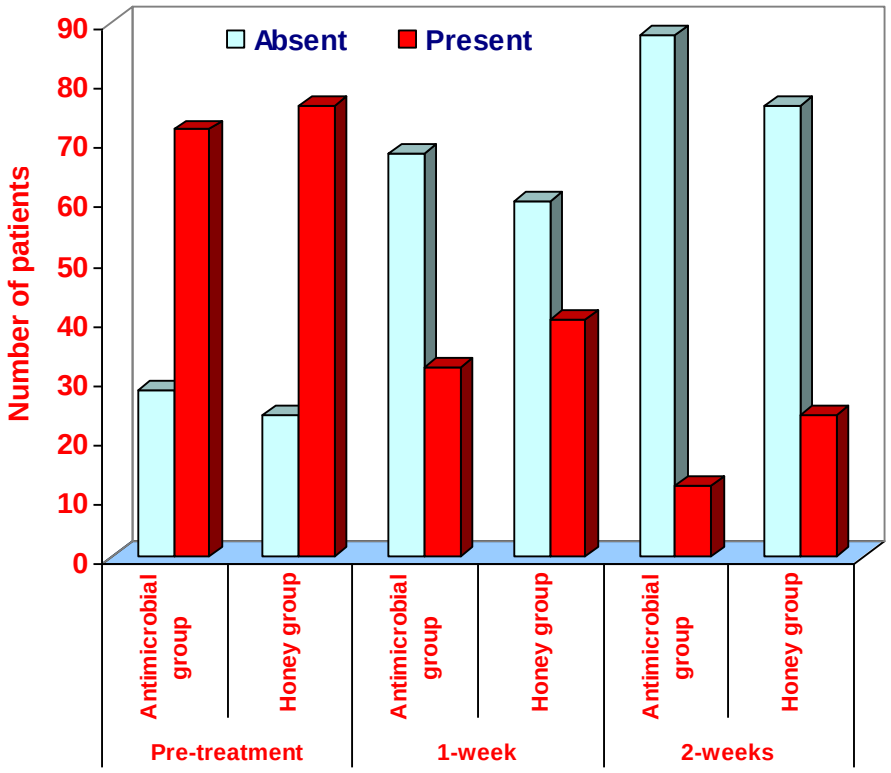
- Topical treatment reduced foreign body sensation significantly in comparison to pre-treatment both at one and two weeks of treatment, with a significant difference in favor of results obtained at 2 weeks, but with a non-significant difference between frequency of patients according to foreign body sensation between both groups, (Table 21, Fig. 39).

Table (21): Patients' distribution according to frequency of foreign body sensation at 1-week and 2-weeks in comparison to pre-treatment pain grade in both groups

Time / FB sensation	Pre-treat		1-w		2-w	
	Antimicrobial group	Honey group	Antimicrobial group	Honey group	Antimicrobial group	Honey group
Absent	28	24	68	60	88	76
Present	72	76	32	40	12	24
P_1			<0.01	<0.01	<0.001	<0.001
P_2					<0.001	<0.001
P_3	>0.05		>0.05		>0.05	

P_1 : significant versus pre-treatment
P_2 : significant versus 1-week
P_3 : significant versus Honey group

Fig. (39): Patients' distribution according to presence of FB sensation in keratitis patients at one & two-weeks of treatment compared to pre-treatment sensation



C) <u>Visual Acuity</u>

- Both lines of treatment could achieve improvement of visual acuity with a significant increase of number of patients with improved visual acuity at 2-weeks in comparison to pretreatment acuity, but with non-significant difference between frequency of patients' visual acuity between both groups (Table 22, Fig. 40-42).

Table (22): Visual acuity achieved at 1-week and 2-weeks in comparison to pre-treatment acuity in both groups

Time / Visual Acuity	Pre-treat		1-week		2-week	
	Antimicrobial group	Honey group	Antimicrobial group	Honey group	Antimicrobial group	Honey group
6/6	0	0	4	0	8	4
6/12	12	8	8	8	20	12
6/18	28	24	36	32	32	28
6/24	24	24	32	28	36	28
6/36	16	20	8	16	4	24
6/60	8	12	4	8	4	4
3/60	8	8	4	4	4	4
1/60	4	4	4	4	0	0

Fig. (40): Changes of the Visual acuity in keratitis patients (Antimicrobial group) at one & two weeks after treatment compared to pre-treatment acuity

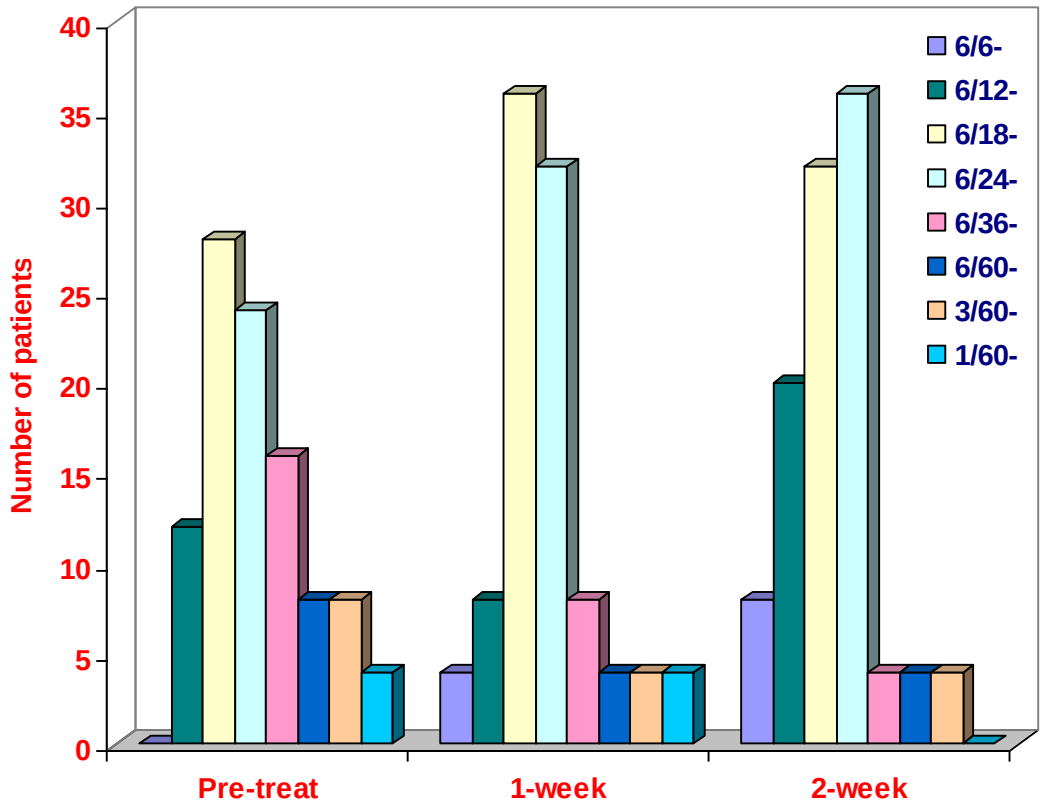


Fig. (41): Changes of the Visual acuity in Keratitis patients (Honey group) at one & two weeks after treatment compared to pre-treatment acuity

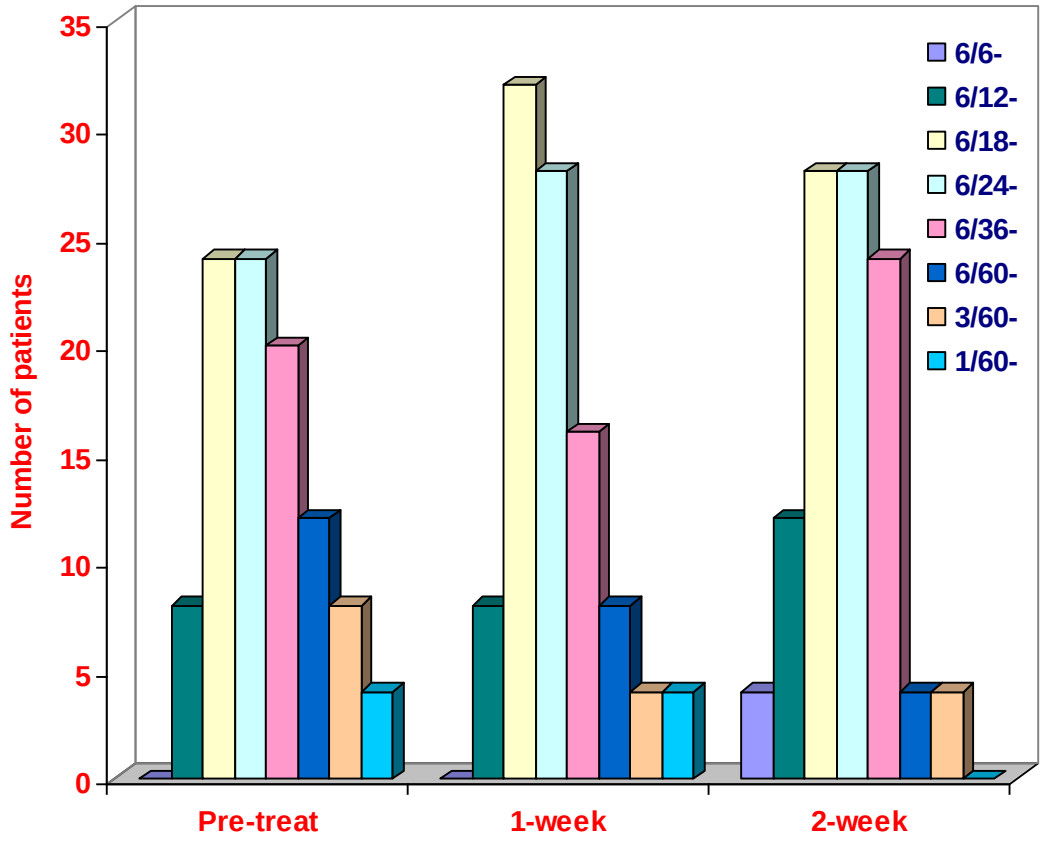
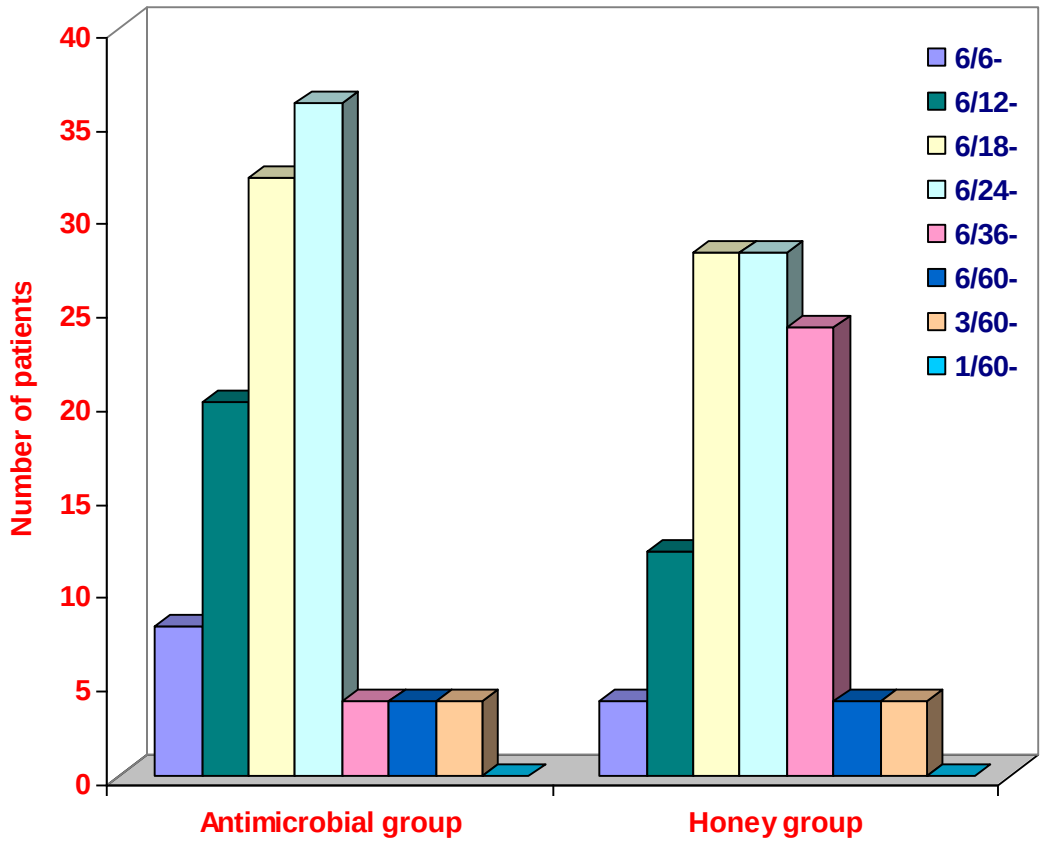


Fig. (42): Visual acuity at two weeks after treatment in Keratitis patients (both groups)



D) Corneal haziness

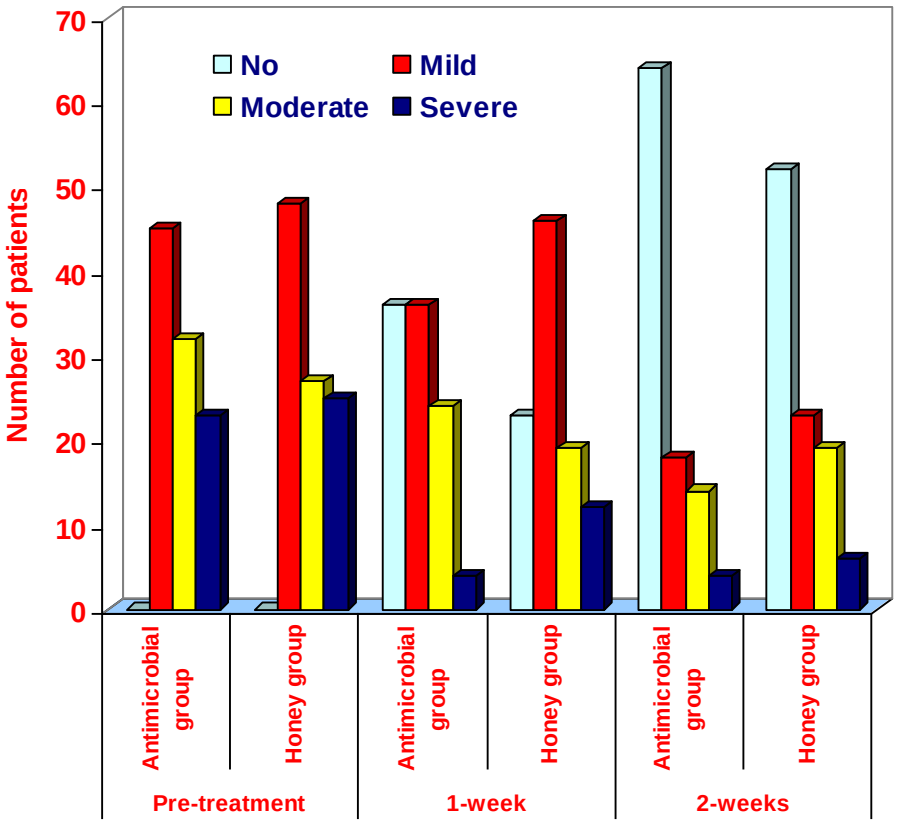
- Topical therapy used in keratitis patients (both groups) significantly reduced the frequency of corneal haziness both at 1 and 2-weeks in comparison to pre-treatment and 1-week frequency.
- Topical honey significantly reduced corneal haziness at end of the first week of therapy compared to antimicrobial topical therapy, but the difference became non-significant at the end of the second week despite being in favor of topical honey, (Table 23, Fig. 43).

Table (23): Patients' distribution according to degree of corneal haziness determined at 1-week and 2-weeks in comparison to pre-treatment degree of haziness

Time	Pre-treat		1-w		2-w	
Corneal haziness	Antimicrobial group	Honey group	Antimicrobial group	Honey group	Antimicrobial group	Honey group
No	0	0	36	23	64	52
Mild	45	48	36	46	18	23
Moderate	32	27	24	19	14	19
Severe	23	25	4	12	4	6
P_1			<0.001	<0.01	<0.001	<0.001
P_2					<0.01	<0.001
P_3			<0.05		>0.05	

P_1: significant versus pre-treatment
P_2: significant versus 1-week
P_3: significant versus Honey group

Fig. (43): Keratitis patients' distribution according to corneal haziness reported at one & two-weeks of treatment compared to pre-treatment grade



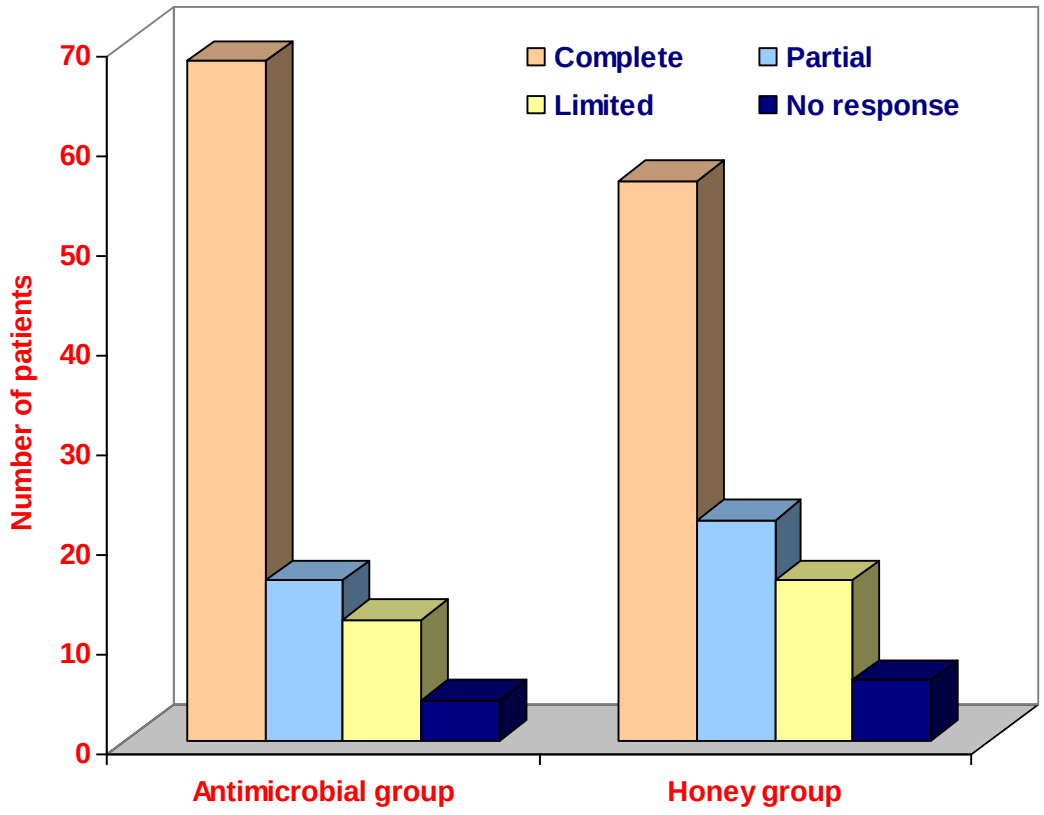
E) <u>Ulcer Healing</u>

- Complete resolution of infection and ulcer healing was reported in 124 eyes (62%); 68 with topical honey and 56 with topical antimicrobials.
- Partial resolution of infection and ulcer healing was reported in 38 eyes (19%); 16 with topical honey and 22 with topical antimicrobials.
- Limited effect was reported in 28 eyes (14%); 12 with topical honey and 16 with topical antimicrobials.
- No response throughout the treatment period was reported in only 10 eyes (5%); 4 with topical honey and 6 with topical antimicrobials.
- There was a non-significant difference in the clinical outcome as regards resolution of infection and healing of the ulcer between both modalities of topical therapy, (X^2=0.082, p>0.05), (Table 24, Fig. 44).

Table (24): Patients' distribution according to extent of resolution of infection and ulcer healing determined after 2-weeks of topical therapy

	Antimicrobial group	Honey group	Total
Complete	68	56	124
Partial	16	22	38
Limited	12	16	28
No response	4	6	10

Fig. (44): Keratitis patients distribution according to the extent of resolution of infection and ulcer healing determined after 2-weeks of topical therapy



F) Corneal Thickness

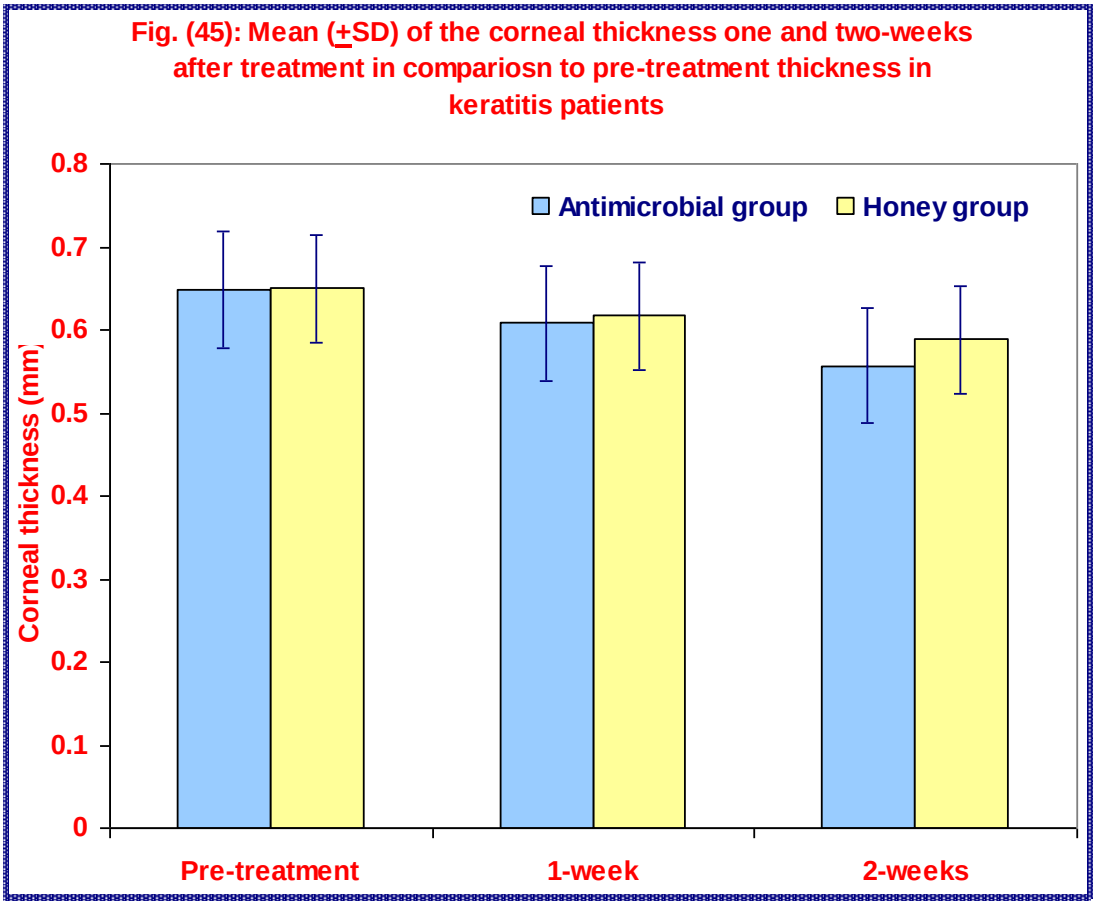
- Both lines of treatment could achieve a reduction of the corneal thickness that progressed from the first week to the second week of treatment in comparison to pretreatment corneal thickness.
- The mean pretreatment corneal thickness was 0.649±0.09 in antimicrobial group and 0.65±0.087 in honey group, while was 0.608±0.088 in antimicrobial group and 0.617±0.08 in honey group at 1-week, and 0.557±0.058 in antimicrobial group and 0.613±0.086 in honey group at 2-weeks.
- In patients with keratitis (both antimicrobial and honey groups), there was a non-significant (P>0.05) decrease at 1-week that became significant (P<0.05) at 2-week visit with a significant (P<0.05) decrease compared to thickness measured at 1-week.
- In antimicrobial group, there was a non-significant (P>0.05) decrease at 1-week that became significant (P<0.05) at 2-week visit with a significant (P<0.05) decrease compared to thickness measured in honey group, (Table 25, Fig. 45).

Table (25): Corneal thickness changes at 1-week and 2-weeks in comparison to pre-treatment thickness in both groups

Time	Group	Mean±SD	Significance
Pre-treatment	Antimicrobial	0.649±0.09	
	Honey	0.65±0.087	
1-Week	Antimicrobial	0.608±0.088	P_1>0.05 P_3>0.05
	Honey	0.617±0.08	P_1>0.05
2-Week	Antimicrobial	0.557±0.058	P_1<0.05 P_2<0.05 P_3<0.05
	Honey	0.588±0.086	P_1<0.05 P_2<0.05

P_1: significant versus pre-treatment P_2: significant versus 1-week
P_3: significant versus honey group

Fig. (45): Mean (±SD) of the corneal thickness one and two-weeks after treatment in compariosn to pre-treatment thickness in keratitis patients



Bacteriological Outcome

- Topical treatment could achieve a microbial eradication 195 of 258 specimens (77.7%) irrespective of the infecting organism, pure or mixed infection or the modality of topical treatment, (Table 26).
- Topical therapy resulted in bacterial eradication in 106 of 135 specimens (78.5%) and in fungal eradication in 89 of 116 specimens (76.7%) with a non-significant difference between the effects of infecting pathogen on the outcome of topical therapy.
- There was a non-significant difference between the effects of topical therapy on pure and mixed infections whether bacterial of fungal, (Table 27).
- Moreover, there was a non-significant difference between the effects of topical honey (Fig. 52) or antimicrobial drugs (Fig. 53) on the microbiological cure rate, (Table 28).

Table (26): Frequency of cure according to the infective pathogens

	Diseased	Cured
Staph. Aureus	34	26 (76.5%)
Pseudomonas aeruginosa	27	23 (85.2%)
Staph. Epidermosa	32	28 (87.5%)
Esch. coli	9	6 (66.7%)
Proteus	3	1 (33.3%)
Streptococci	7	5 (71.4%)
Micrococcus luteus	13	10 (76.9%)
Bacillus cerus	10	7 (70%)
C. albicans	46	39 (84.8%)
Aspergillus fumigatus	27	22 (81.5%)
Fusarium solani	19	12 (63.2%)
Aspergillus niger	14	10 (71.4%)
Penicillium species	10	6 (60%)
	251	195 (77.7%)

Table (27): Effect of topical therapy on growth of infective pathogens detected in the corneal smears categorized as pure or mixed infections

	Pure infection		Mixed infection	
	Diseased	**Cured**	**Diseased**	**Cured**
Staph. Aureus	13	10	21	16
Ps. aeruginosa	10	8	17	15
Staph. Epidermosa	12	12	20	16
Esch. coli	5	3	4	2
Proteus	2	1	1	0
Streptococci	4	3	3	2
Micrococcus luteus	6	5	7	5
Bacillus cerus	4	3	6	4
C. albicans	14	11	32	28
Aspergillus fumigatus	9	7	18	15
Fusarium solani	6	5	13	7
Aspergillus niger	5	4	9	6
Penicillium species	3	2	7	5
Total	93	74	158	121

Table (28): The microbiological cure rates after topical honey compared to topical antimicrobial therapy

	Antimicrobial group		Honey group	
	Diseased	**Cured**	**Diseased**	**Cured**
Staph. Aureus	17	17 (100%)	17	9 (52.9%)
Ps. aeruginosa	15	11(73.3%)	12	12 (100%)
Staph. Epidermosa	17	14 (82.4%)	15	13 (86.7%)
Esch. coli	5	3 (60%)	4	3 (75%)
Proteus	2	1 (50%)	1	0 (0%)
Streptococci	4	3 (75%)	3	2 (66.7%)
Micrococcus luteus	6	4 (66.7%)	7	6 (85.7%)
Bacillus cerus	4	2 (50%)	6	5 (83.3%)
C. albicans	23	17 (73.9%)	23	22 (95.6%)
Aspergillus fumigatus	13	10 (76.9%)	14	12 (85.7%)
Fusarium solani	9	6 (66.7%)	10	6 (60%)
Aspergillus niger	8	5 (62.5%)	6	5 (83.3%)
Penicillium species	5	4 (80%)	5	3 (60%)
Total	128	97 (75.8%	123	98 (79.7%)

Fig. (46): Microbiological outcome after topical Honey therapy

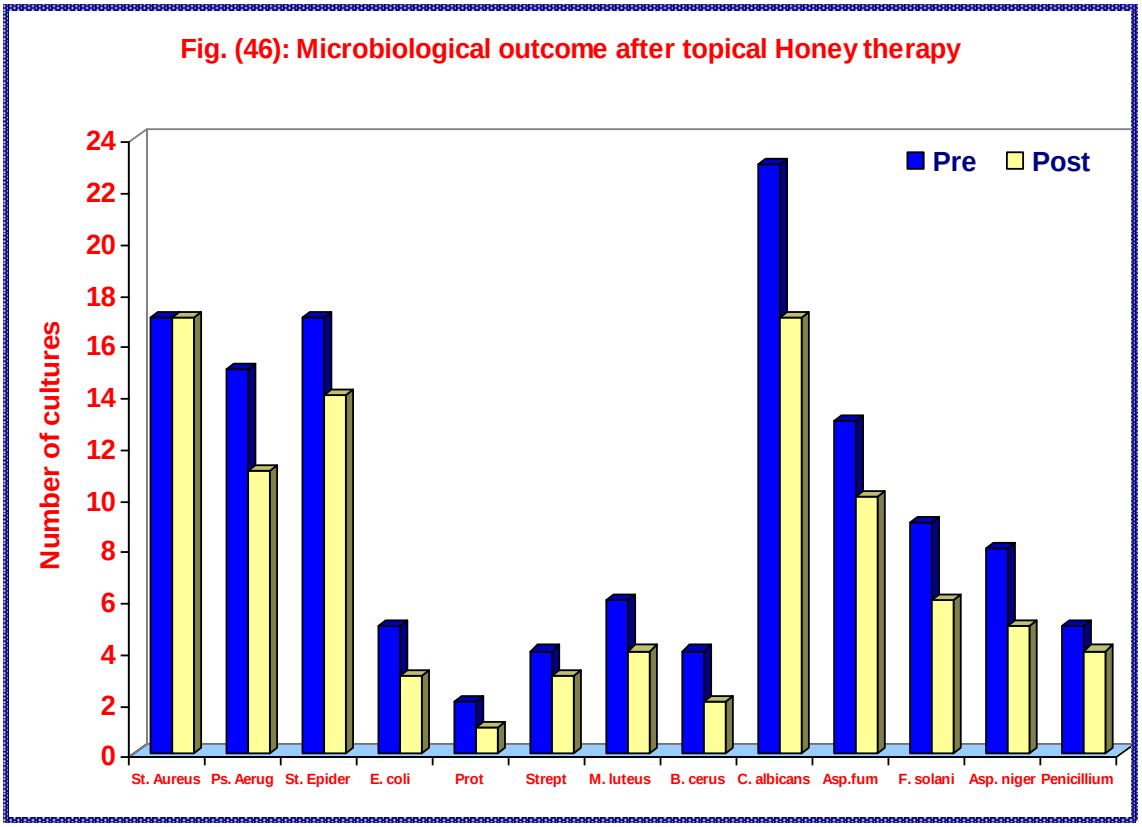
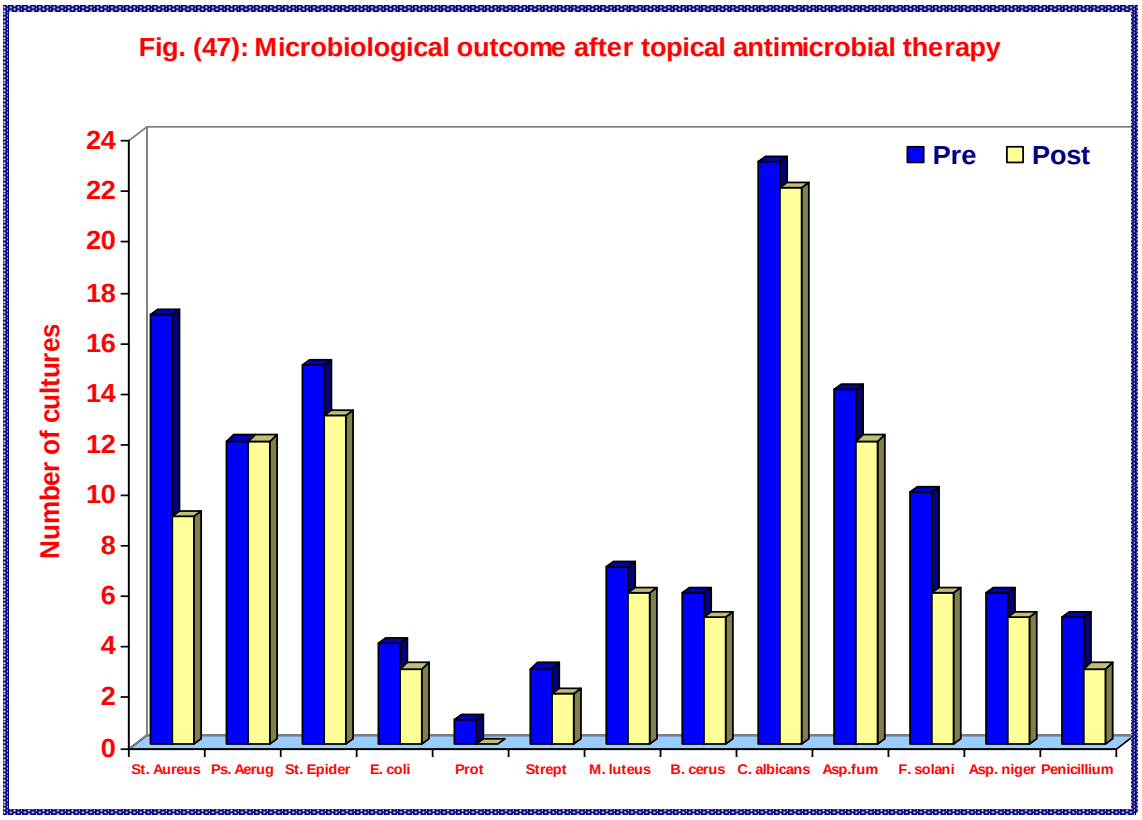


Fig. (47): Microbiological outcome after topical antimicrobial therapy



Keratopathy Group

Patients' characteristics

Age and Sex distribution

Keratopathy group comprised 50 patients; 26 males and 24 females with a male:female ratio= 13:12. Mean age of male patients was 56.5±6.7; range: 48-72 years, whereas that of female patients was 61.6±5.1; range, 50-72 years, with a non-significant difference (P>0.05) between both sexes as regards age distribution, (Table 29).

Moreover, there was a non-significant (X^2=0.423, P>0.05) difference between number of patients with keratopathy randomly allocated in both treatment groups as regards sex distribution. Also, there was a non-significant difference between both treatment groups as regards age of patients included, (Table 30)

Table (29): Keratopathy patients' distribution according to gender and age

	Males	Females
Number (%)	26 (52%)	24 (48%)
Age (years)	56.5±6.7 (48-72)	61.6±5.1 (50-72)

Data are presented as number & mean±SD, percentages & ranges are in parenthesis

Table (30): Keratopathy patients' distribution according to gender and age among both groups

	Antimicrobial group (n=25)	Honey group (n=25)
M:F	14:11	12:13
Age (years)	58.3±6.1 (48-72)	59.6±6.9 (48-72)

Data are presented as ratios & mean±SD, ranges are in parenthesis

Occupation

The majority of patients were farmers; 24 patients (48%) with male to female ratio of 1.8:1, 12 patients (24%) were manual workers with male to female ratio of 1.4:1 and 9 patients (18%) were employees with male to female ratio of 2:1. Five female patients (10%) were housewives, (Table 31, Fig. 6).

Table (31): Keratopathy patients' distribution according to their occupation

Sex / Occupation	Males	Females	Total
Employees	6 (23.1%)	3 (12.5%)	9 (18%)
Farmer	13 (50%)	11 (45.9%)	24 (48%)
Workers	7 (26.9%)	5 (20.8%)	12 (24%)
Housewives	0	5 (20.8%)	5 (10%)
Total	26 (52%)	24 (48%)	50 (100%)

General Diseases

Thirty patients (58%) free of systemic diseases; while the other 20 patients had variant systemic diseases. Nine patients (18%) were diabetics, 4 patients (8%) had arthritis, 3 patients (6%) had liver disease and 3 patients had renal impairment, (Table 32, Fig. 49). There was a non-significant difference between patients included in antimicrobial and honey groups as regards the frequency of systemic diseases, (X^2=0.873, P>0.05).

Table (32): Keratopathy patients' distribution according to the presence of systemic diseases

Group		Antimicrobial	Honey	Total
No systemic diseases (n=30)		16	14	160 (80%)
Systemic diseases (n=20)	**Diabetes mellitus**	4	5	13 (6.5%)
	Arthritis	2	2	10 (5%)
	Liver diseases	1	2	9 (4.5%)
	Renal impairment	2	2	3 (1.5%)
Total		25	25	50 (100%)

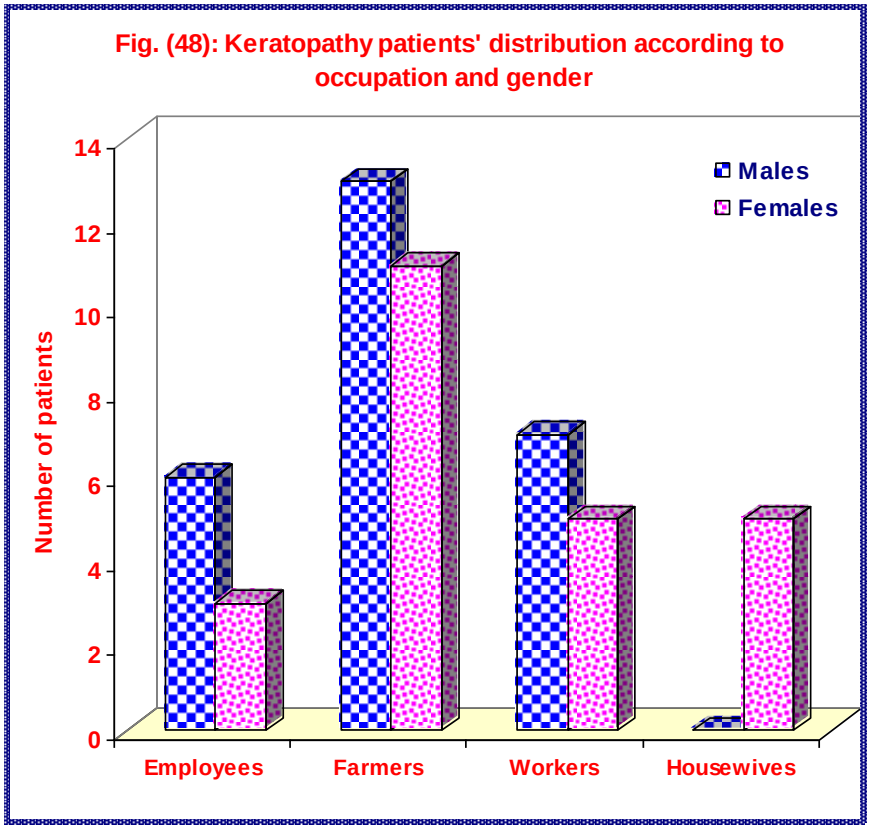
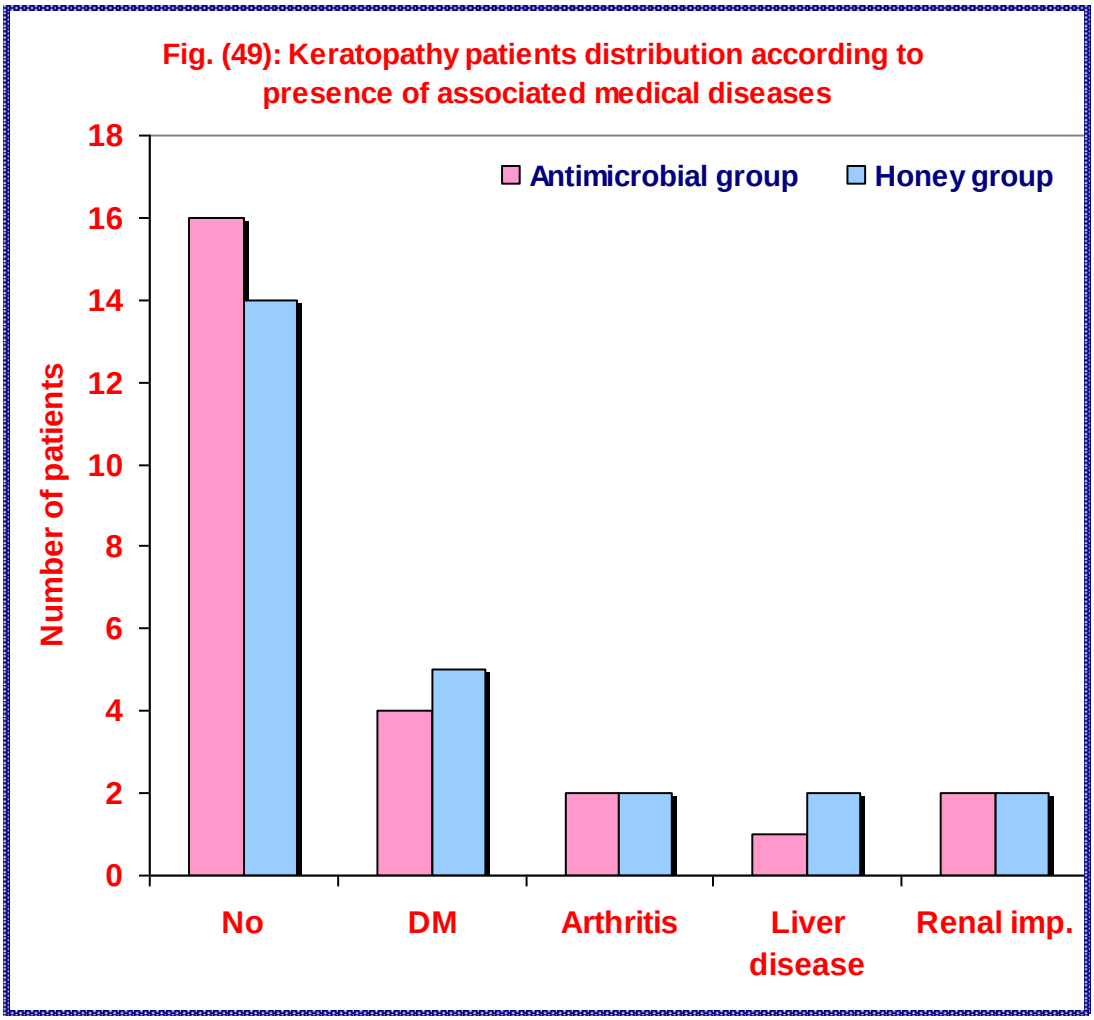


Fig. (48): Keratopathy patients' distribution according to occupation and gender
Number of patients
0
2
4
6
8
10
12
14
Males
Females
Employees
Farmers
Workers
Housewives

Fig. (49): Keratopathy patients distribution according to presence of associated medical diseases



Ophthalmic Examination

Corneal Bullae

Twenty-eight patients (56%) had corneal edema; 15 in antimicrobial group and 13 patients in honey group. While the other 22 patients (44%) had corneal bullae 10 in antimicrobial group and 12 patients in honey group with a non-significant difference between both groups, (X^2=0.108, P>0.05), (Fig. 50).

Pain sensation

Only 3 patients (6%) had no pain on touch, 13 patients (26%) had mild pain, 29 patients (58%) had moderate pain and 11 patients (22%) had severe pain. There was a non-significant difference between antimicrobial and honey groups, (X^2=0.234, P>0.05) as regards the grade of pain on corneal touch, (Table 33, Fig. 51).

Table (33): Keratopathy patients' distribution according to the degree of pain on corneal touch

	Antimicrobial group	Honey group	Total
No	2 (8%)	1 (4%)	3 (6%)
Mild	6 (24%)	7 (28%)	13 (26%)
Moderate	12 (48%)	11 (44%)	29 (58%)
Severe	5 (20%)	6 (24%)	11 (22%)
Total	25 (100%)	25 (100%)	50 (100%)

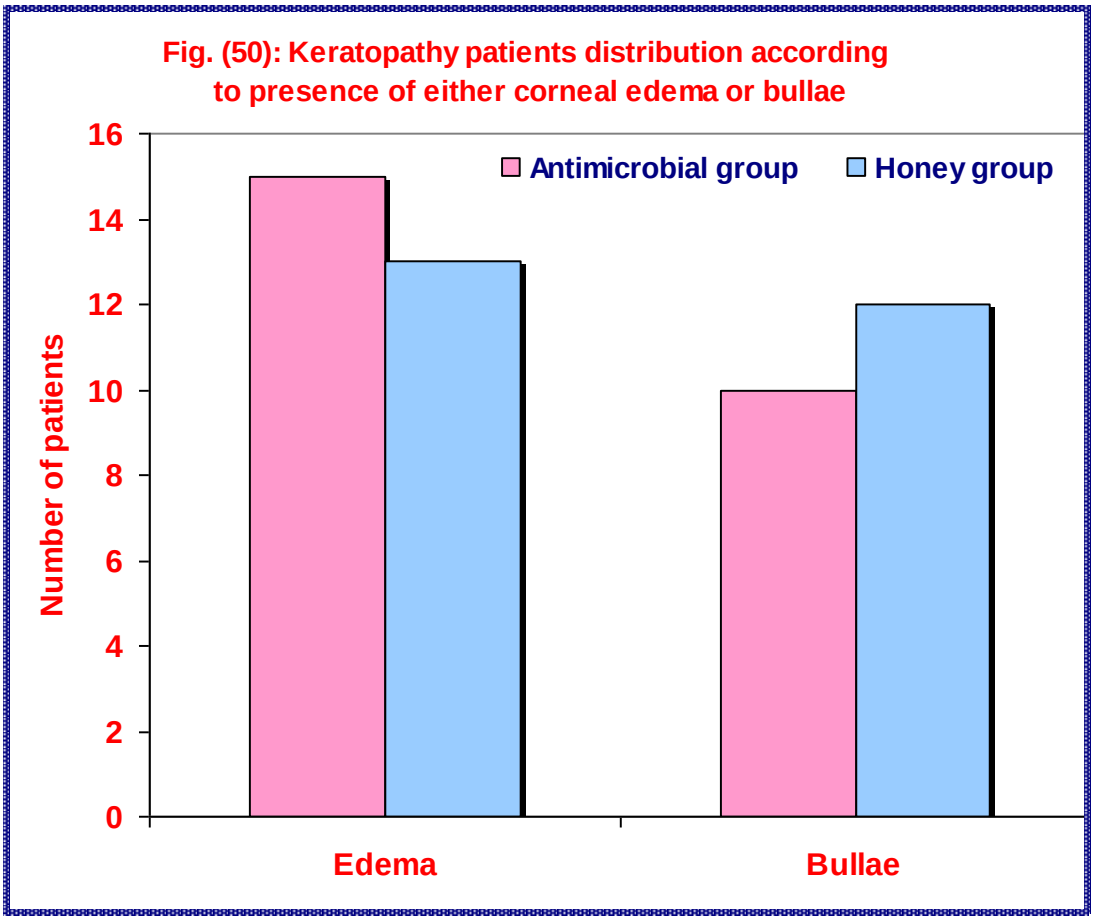


Fig. (50): Keratopathy patients distribution according to presence of either corneal edema or bullae
Antimicrobial group
Honey group
Number of patients
16
14
12
10
8
6
4
2
0
Edema
Bullae

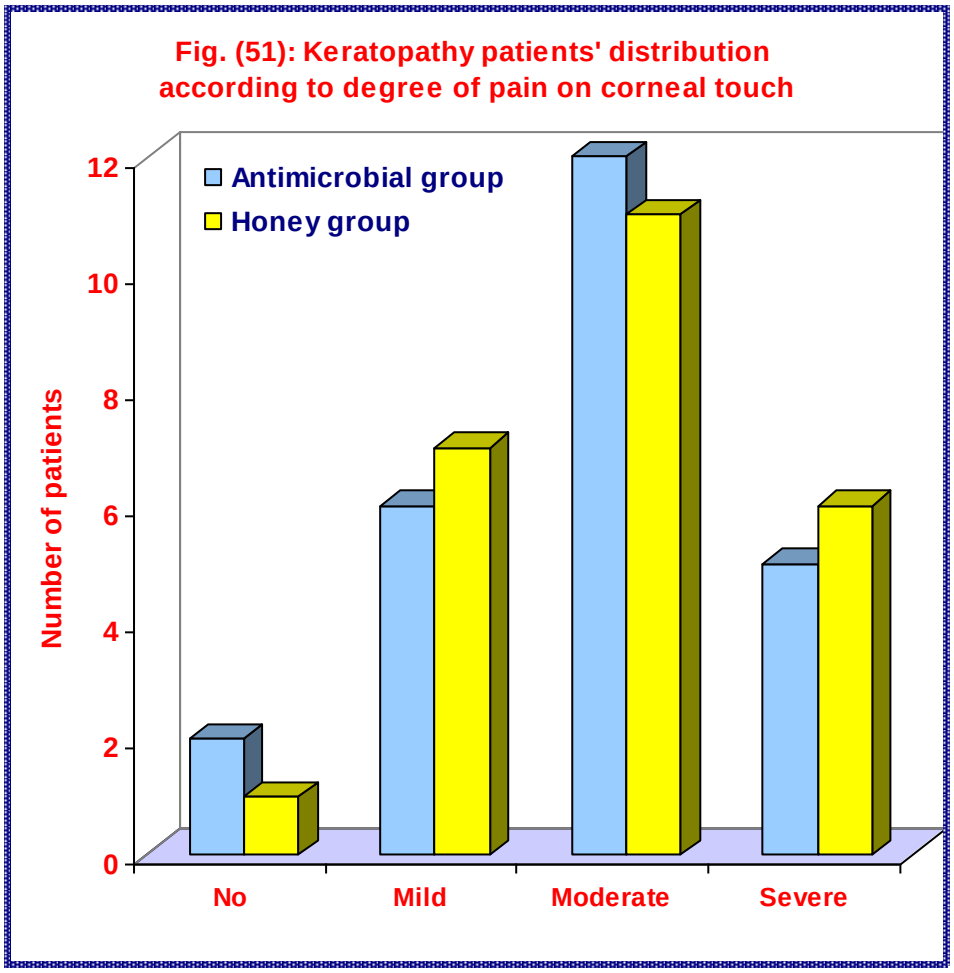


Fig. (51): Keratopathy patients' distribution according to degree of pain on corneal touch
Antimicrobial group
Honey group
Number of patients
0
2
4
6
8
10
12
No
Mild
Moderate
Severe

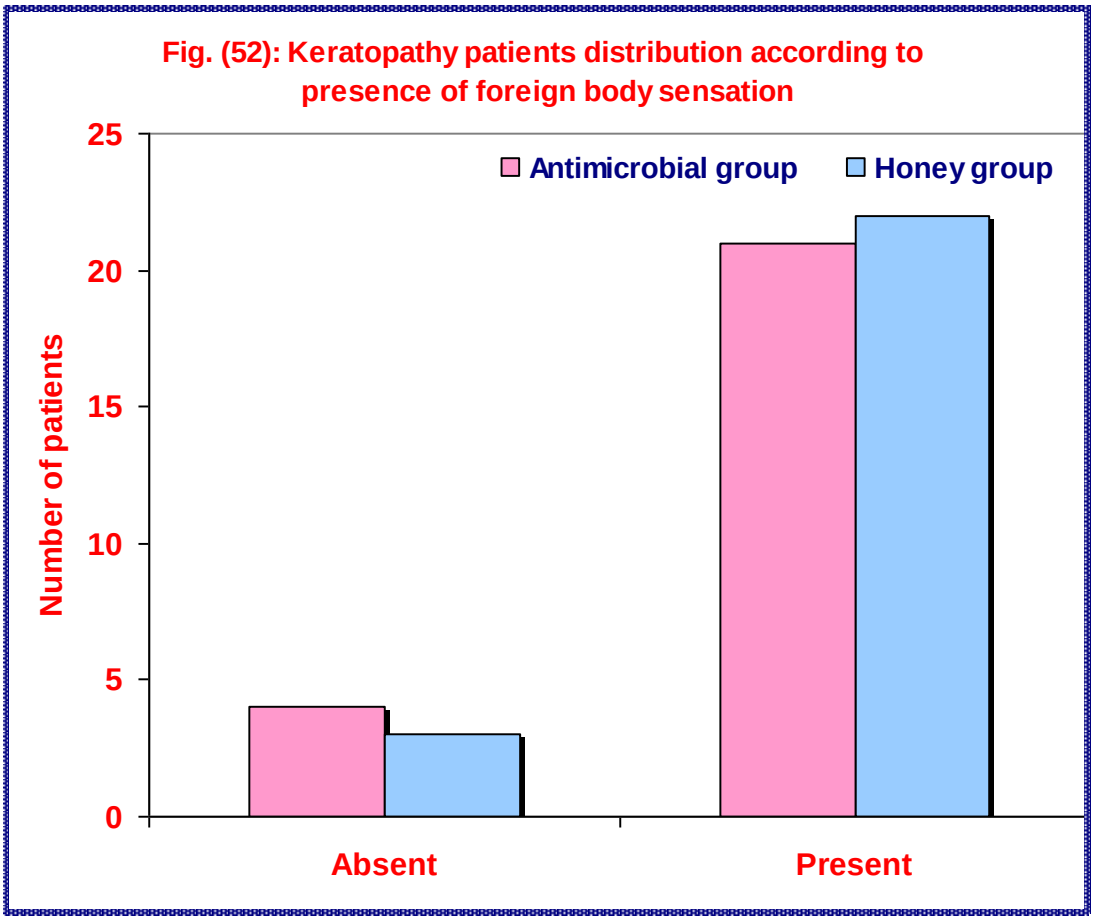
Foreign body sensation

Seven patients (14%) had no foreign body sensation, while the other 43 patients had foreign body sensation. There was a non-significant difference between antimicrobial and honey groups, (X^2=0.538, P>0.05) as regards the grade of pain on corneal touch, (Table 34, Fig. 52).

Table (34): Keratopathy patients' distribution according to the presence of foreign body sensation

	Antimicrobial group	Honey group	Total
Absent	4 (16%)	3 (12%)	7 (14%)
Present	21 (84%)	22 (88%)	43 (86%)
Total	25 (100%)	25 (100%)	50 (100%)

Fig. (52): Keratopathy patients distribution according to presence of foreign body sensation



Corneal Haziness

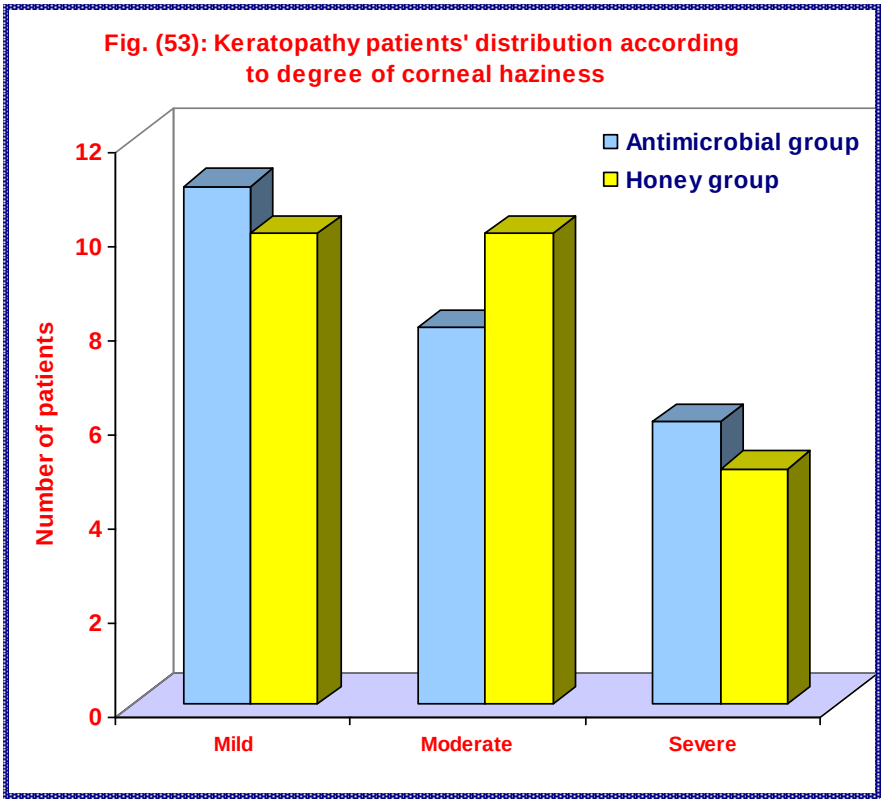
Twenty-one patients (42%) had mild corneal haziness, 18 patients (36%) had moderate corneal haziness and 11 patients (22%) had severe corneal haziness. There was a non-significant difference between antimicrobial and honey groups, (X^2=0.705, P>0.05) as regards the degree of corneal haziness, (Table 35, Fig. 53).

Table (35): Keratopathy patients' distribution according to degree of corneal haziness

	Antimicrobial group	Honey group	Total
Mild	11 (44%)	10 (40%)	21 (42%)
Moderate	8 (32%)	10 (40%)	18 (36%)
Severe	6 (24%)	5 (20%)	11 (22%)
Total	25 (100%)	25 (100%)	50 (100%)

Ophthalmic Diagnosis (Case Presentation)

Figure (54) represents postoperative keratopathy showing corneal epithelial edema (a) and bullous keratopathy (b).



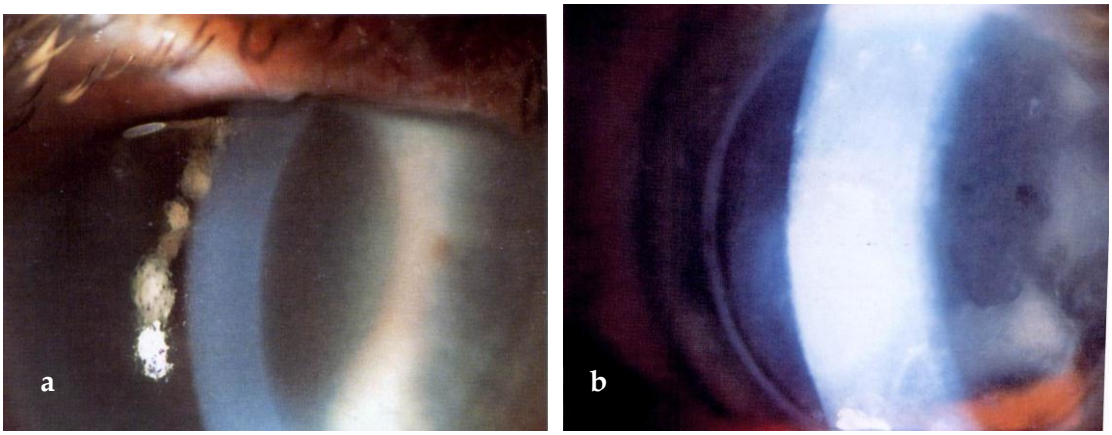


Fig. (54):a: Corneal epithelial edema
b: Bullous keratopathy

Clinical Outcome

A) Pain

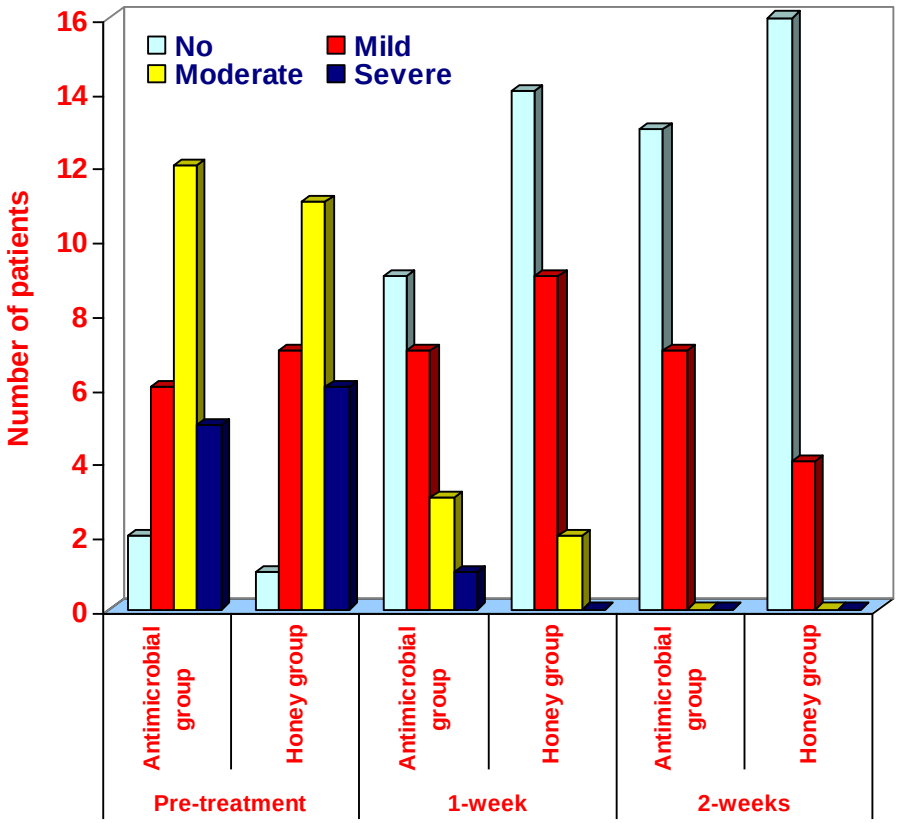
- Both lines of treatment could achieve dramatic pain relief with a significant increase in number of patients with less pain-grade at 1-week and 2-weeks in comparison to pretreatment pain grade with a non-significant difference between the frequencies of pain grades reported 2-weeks after local therapy compared to that reported on the first week. Moreover, there was a non-significant difference between frequency of patients according to pain grade between both groups throughout the study period (Table 36, Fig. 55).

Table (36): Pain grade determined at 1-week and 2-weeks in comparison to pre-treatment pain grade in both groups

Time / Pain grade	Pre-treat		1-w		2-w	
	Antimicrobial group	Honey group	Antimicrobial group	Honey group	Antimicrobial group	Honey group
No	2	1	9	14	13	16
Mild	6	7	7	9	7	4
Moderate	12	11	3	2	0	0
Severe	5	6	1	0	0	0
P_1			<0.01	<0.001	<0.001	<0.001
P_2					>0.05	>0.05
P_3	>0.05		>0.05		>0.05	

P_1 : significant versus pre-treatment
P_2 : significant versus 1-week
P_3 : significant versus Honey group

Fig. (55): Patients' distribution according to pain sensation grade in keratopathy patients at one & two-weeks of treatment compared to pre-treatment grade



B) Foreign body sensation

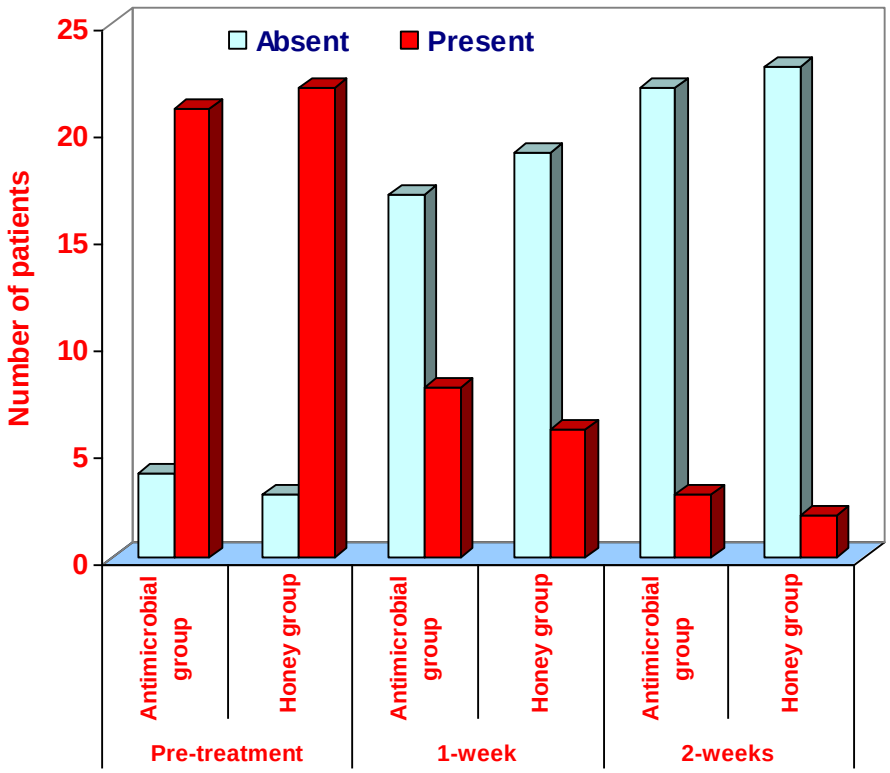
- Topical treatment reduced foreign body sensation significantly in comparison to pre-treatment both at one and two weeks of treatment, with a significant difference in favor of results obtained at 2 weeks, but with a non-significant difference between frequency of patients according to foreign body sensation between both groups, (Table 37, Fig. 56).

Table (37): Patients' distribution according to frequency of foreign body sensation at 1-week and 2-weeks in comparison to pre-treatment pain grade in both groups

Time / FB sensation	Pre-treat		1-w		2-w	
	Antimicrobial group	Honey group	Antimicrobial group	Honey group	Antimicrobial group	Honey group
Absent	4	3	17	19	22	23
Present	21	22	8	6	3	2
P_1			<0.01	<0.001	<0.001	<0.001
P_2					<0.001	<0.001
P_3	>0.05		>0.05		>0.05	

P_1 : significant versus pre-treatment
P_2 : significant versus 1-week
P_3 : significant versus Honey group

Fig. (56): Patients' distribution according to presence of FB sensation in keratopathy patients at one & two-weeks of treatment compared to pre-treatment sensation



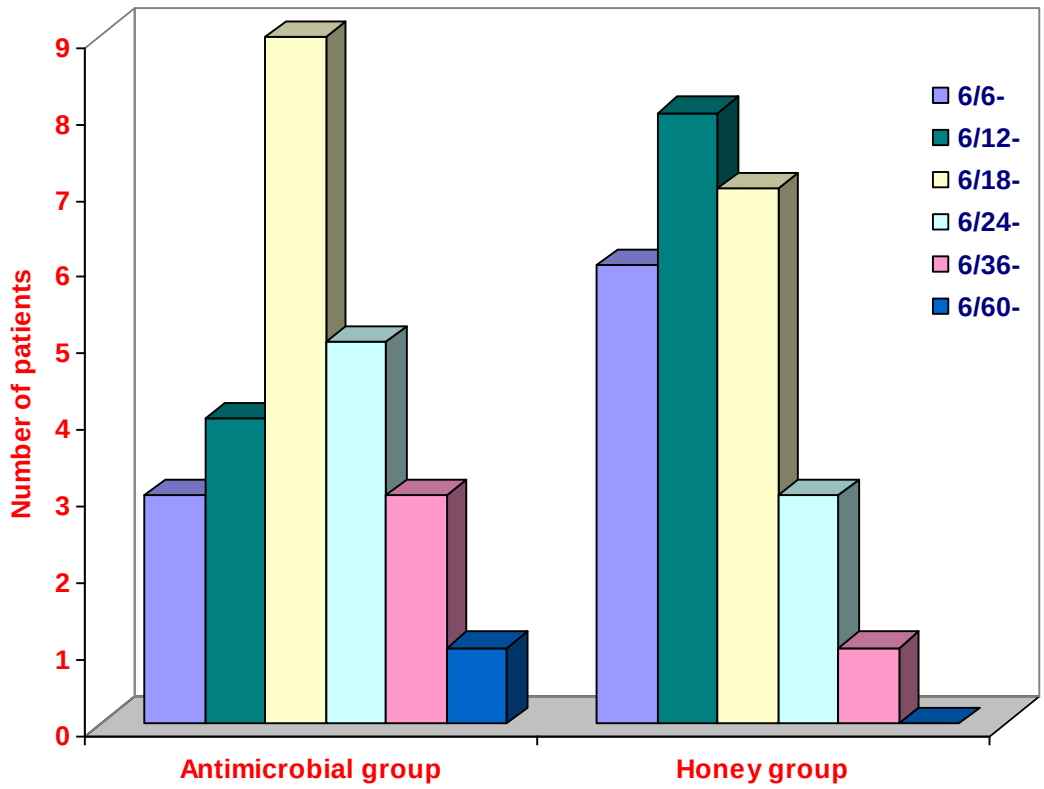
C) Visual Acuity

- Both lines of treatment could achieve improvement of visual acuity with a significant increase of number of patients with improved visual acuity at 2-weeks in comparison to pretreatment acuity, but with non-significant difference between frequency of patients' visual acuity between both groups (Table 38, Fig. 57).

Table (38): Visual acuity achieved at 1-week and 2-weeks in comparison to pre-treatment acuity in both groups

Time	Pre-treat		1-week		2-week	
Visual Acuity	Antimicrobial group	Honey group	Antimicrobial group	Honey group	Antimicrobial group	Honey group
6/6	0	0	2	4	3	6
6/12	6	7	7	6	4	8
6/18	8	6	7	5	9	7
6/24	5	4	3	4	5	3
6/36	2	3	2	3	3	1
6/60	1	2	3	2	1	0
3/60	2	1	1	1	0	0
1/60	1	2	0	0	0	0

Fig. (57): Visual acuity at two weeks after treatment in Keratopathy patients (both groups)



D) Corneal haziness

- Topical therapy used in keratopathy patients (both groups) significantly reduced the frequency of corneal haziness both at 1 and 2-weeks in comparison to pre-treatment, (Table 39, Fig. 58).

Table (39): Patients' distribution according to degree of corneal haziness determined at 1-week and 2-weeks in comparison to pre-treatment degree of haziness

Time	Pre-treat		1-w		2-w	
Corneal haziness	Antimicrobial group	Honey group	Antimicrobial group	Honey group	Antimicrobial group	Honey group
No	0	0	11	16	17	21
Mild	8	10	11	7	7	4
Moderate	6	5	3	2	1	0
Severe	11	10	0	0	0	0
P_1			<0.001	<0.01	<0.001	<0.001
P_2					<0.01	<0.001
P_3			<0.05		>0.05	

P_1: significant versus pre-treatment
P_2: significant versus 1-week
P_3: significant versus Honey group

Fig. (58): Keratopathy patients' distribution according to corneal haziness reported at one & two-weeks of treatment compared to pre-treatment grade