RESULTS

1. Microbial load and chemical properties of fresh *Oreochromis niloticus* flesh:

Data represented in table (1) showed the microbial load of fresh tilapia the results indicated that the total viable bacterial counts and psychrophillic bacteria were $2.7x10^4$ and $2.2x10^4$ cfu/g respectively.

The initial counts of pathogenic microorganisms Enterococci, Staphylococci and *Bacillus cereus* were $4.8x10^2$,$5.6x10^2$ and $3.8x10^2$ cfu/g respectively. It could be noticed that the fish samples were found to be free from *Salmonella* and *Shigilla*. The total yeast and mould were 1.0x10 cfu/g and (the fish samples were found to be free from yeast).

The chemical properties of fresh tilapia were also evaluated and cited in table (1). The result indicated that the moisture, pH value, total volatile basic nitrogen and thiobarbutaric acid were 81.98%, 6.45, 8.48 mg.N/100g, and 0.014 OD respectively.

2. Effect of freezing process and frozen storage on the total microbial load and chemical properties of *O. niloticus* flesh at -18°C:

2.1. Effect of freezing and frozen storage on the total microbial load of *O. niloticus* flesh:

The results in table (2) indicated that the initial count of total viable count , psychrophillic bacteria and total yeast and mould were $2.7x10^4 \pm 2.3$ $x10^3$, $2.2x10^4 \pm 1.1x10^4$ and 10 ±0.000 cfu/g respectively on fresh tilapia at zero time and decreased gradually significantly throughout storage period at -18^oC reached to $4.4x10^2 \pm 5.7$, $7.3x10^3 \pm 5.7$ and not detected ±0.0 cfu/g respectively after 3 months of frozen storage.

Table (1): Microbial load and chemical properties of fresh *O. niloticus* flesh.

Total viable bacterial count (cfu/g)	$2.7x10^4$
Psychrophillic bacteria (cfu/g)	$2.2x10^4$
Enterococci (cfu/g)	$4.8x10^2$
Staphylococci (cfu/g)	$5.6x10^2$
Bacillus cereus (cfu/g)	$3.8x10^2$
Salmonella and *Shigella* (cfu/g)	ND
Mould (cfu/g)	1x10
Yeast (cfu/g)	ND
Moisture%	81.98%
Total volatile base nitrogen (mg.N/100g)	8.48
Thiobarbituric acid (OD at λ_{max}538)	0.014
pH- value	6.54

OD: optical density
ND: not detected

Table (2): Effect of freezing and frozen storage at -18 ±1 ˚C on the total viable bacterial count, psychrophillic bacteria and total yeast and mold (cfu/g) of *O. niloticus* flesh.

Storage period (Months)	Total viable bacterial count	Psychrophillic bacteria	Total yeast and mould
Zero time	$2.7x10^4$ $\pm 2.3\ x10^3$ ^{a}	$2.2x10^4$ $\pm 1.1x10^4$ ^{a}	10 ± 0.000 ^{a}
1	$2.6x10^4$ $\pm 1.1\ x10^3$ ^{a}	$1.5x10^4$ $\pm 1.1\ x10^4$ ^{b}	6.0 ± 3.3 ^{b}
2	$6.1x10^3$ $\pm 1.7\ x10^2$ ^{b}	$3.1x10^3$ $\pm 2.3x10^2$ ^{c}	ND ^{c} ± 0.0
3	$4.4x10^2$ ± 5.7 ^{c}	$7.3x10^2$ ± 5.7 ^{c}	ND ^{c} ± 0.0

ND Not detected
Means carrying different superscripts are significant at ($p \leq 0.05$)
a-c increasing

Data in table (3) also showed that the initial count of Enterococci, Staphvlococci and *Bacillus cereus* were $4.8x10^2 \pm 34.6$, $5.6x10^2 \pm 5.7$, $3.8x10^2 \pm 23.0$ cfu/g respectively at zero time and decreased gradually significantly throughout storage period at -18^{o}C reached to 35 ±0.57; 0 ±0.0 and 6 ±3.3 respectively after 3 months of frozen storage.

2.2. Effect of freezing process and frozen storage on chemical properties of *Oreochromis niloticus* flesh:

The result in table (4) decided that the initial value of total volatile basic nitrogen, thiobarbutric acid and pH were 8.48 ±5.7 mg.N/100g, 0.014 ±0.0 OD and 6.54 ±5.8 respectively at zero time and increased significantly throughout storage period at -18^o C and reached 14.87 ±0.1mg.N/100 g , 0.200 ±1.7 OD and 6.77 ±5.7 respectively after 3 months of frozen storage. On the other hand the initial value of moisture was 81.98% ±5.7 at zero time and decreased significantly gradually throughout storage period reached to 76.36% ±2.8 respectively after 3 months of frozen storage.

Table (3) Effect of freezing and frozen storage at -18 ±1˚C on the count of Enterococci, Staphylococci and *Bacillus cereus* (cfu/g) of *O. niloticus* flesh .

Storage period (Months)	Enterococci	Staphylococci	*Bacillus cereus*
Zero time	$4.8x10^2$ ±34.6 ^{a}	$5.6x10^2$ ±5.7 ^{a}	$3.8x10^2$ ±23.0 ^{a}
1	$3.3x10^2$ ±11.5 ^{b}	1.5x10 ±1.1 ^{b}	$2.2x10^2$ ±6.6 ^{b}
2	$1.7x10^2$ ±11.5 ^{c}	1.6x10 ±1.7 ^{b}	2.6x10 ±1.7 ^{c}
3	35 ±0.57 ^{d}	ND ±0.0 ^{c}	6 ±3.3 ^{c}

ND Not detected
Means carrying different superscripts are significant at ($p \leq 0.05$)
a-d increasing

Table (4) Effect of freezing and frozen storage at -18 ±1˚C on the chemical properties of *O. niloticus* flesh

Storage period (months)	Moisture%	TVBN (mgN/100g)	TBA (OD at λ_{max}538)	pH
Zero time	81.98 ±5.7 ^{a}	8.48 ±0.2 ^{a}	0.014 ±0.0 ^{a}	6.54 ±5.8 ^{a}
1	80.99 ±1.2 ^{b}	8.60 ±2.3 ^{a}	0.145 ±5.8 ^{b}	6.56 ±0.0 ^{b}
2	77.32 ±5.7 ^{c}	14.70 ±5.7 ^{b}	0.162 ±0.0 ^{c}	6.65 ±1.1 ^{c}
3	76.36 ±2.8 ^{d}	14.87 ±0.1 ^{b}	0.200 ±1.7 ^{d}	6.77 ±5.7 ^{c}

Means carrying different superscripts are significant at ($p \leq 0.05$)
a-d increasing

3. Effect of gamma irradiation on the microbial load and chemical properties of *O. niloticus* flesh during cold storage at 4° C ±1:

3.1. Effect of gamma irradiation on the total viable bacterial count, psychrophillic bacteria and total yeast and mould of *O. niloticus* flesh during cold storage at 4° C ±1:

Data in table (5) showed and fig (1) illsaturated the application of gamma irradiation which led to a great reduction in the microorganisms of irradiated fish samples. Immediately after irradiation process the total viable counts decreased significantly from $2.7x10^4 \pm 2.3$ $x10^3$ cfu/g. in the control samples reached to $3.1x10^2 \pm 4.1$ x10 and 40 ±0.5 cfu/g. after exposing fish samples to 1 and 3 kGy, respectively. The total bacterial count gradually increased significantly in the control samples and increased in irradiated samples by increasing the cold storage period. The samples were rejected after 6,26 and 30 days and the total bacterial counts reached to $2.2x10^7 \pm 1.7$ $x10^6$, $6.1x10^7 \pm 3.5x10^5$ and $4.7x10^7 \pm 3.4$ $x10^6$ cfu/g, respectively.

It could be noticed that irradiation at dose 1 and 3 kGy had great effect on Psychrophillic bacteria decreased from $2.2x10^4 \pm 1.1$ $x10^3$ cfu/g. for control sample to $1.2x10^3 \pm 5.7$x10 cfu/g. for fish samples subjected to 1 kGy, and not detected when subjected to 3 kGy. The same table and fig (2) also indicated a significant increase in psychrophillic bacteria during increasing storage period at 4 °C ±1 in control samples and fish samples subjected to 1 and 3 kGy which reached $3.3x10^7 \pm 5.7$ $x10^6$, $8.4x10^5 \pm 2.9$ $x10^4$ and $1x10^6 \pm 3.3$ $x10^4$ cfu/g. respectively after 6, 26 and 30 days.

Table (5) and fig (3) also indicated that the initial yeast and mould count of control fish samples at zero time was 10 ±0.00 cfu/g., and this count gradually increased reached to 30 ±5.7 cfu/g. after 6 days of cold storage and disappeared when subjected to 1 and 3 kGy . Finally, 1 and 3 kGy increased the shelf-life of the fish samples to 26, 30 days respectively. At this stage the samples became completely rejected.

Table(5) Effect of gamma irradiation on the total viable bacterial count , psychrophillic bacteria and total yeast and mould (cfu/g) of *Oreochromis niloticus* flesh during cold storage at 4˚C±1:

Storage period (Days)	Total viable bacterial count			Psychrophillic bacteria			Total yeast and mould		
	control	1KGy	3KGy	control	1KGy	3KGy	control	1KGy	3KGy
Zero time	$2.7 \times 10^{4} \pm 2.3 \times 10^{3}$ Aa	$3.1 \times 10^{2} \pm 4.1 \times 10^{}$ Ba	$4 \times 10 \pm 0.5^{}$ Ba	$2.2 \times 10^{4} \pm 1.1 \times 10^{3}$ Aa	$1.2 \times 10^{3} \pm 5.7 \times 10^{}$ Ba	ND $\pm 0.00^{}$ Ba	$1.0 \times 10 \pm 0.00^{}$ Aa	ND	ND
3	$7.2 \times 10^{6} \pm 1.4 \times 10^{5}$ Ac	$1.6 \times 10^{3} \pm 8.8 \times 10^{}$ Ba	$2.5 \times 10^{2} \pm 8.8^{}$ Ba	$2.8 \times 10^{6} \pm 2.3 \times 10^{5}$ Ab	$8.3 \times 10^{3} \pm 3.3 \times 10^{2}$ Ba	ND $\pm 0.00^{}$ Ba	$1.5 \times 10 \pm 2.8^{}$ Aa	ND	ND
6	$2.2 \times 10^{7} \pm 1.7 \times 10^{6}$ Ad	$6.8 \times 10^{3} \pm 1.7 \times 10^{2}$ Ba	$7 \times 10^{2} \pm 1.1 \times 10^{2}$ Ba	$3.3 \times 10^{7} \pm 5.7 \times 10^{6}$ Ac	$1.4 \times 10^{4} \pm 1.1 \times 10^{3}$ Ba	$9.3 \times 10^{2} \pm 1.7 \times 10^{}$ Ba	$3.0 \times 10 \pm 5.7^{}$ Aa	ND	ND
10	®	$1.4 \times 10^{4} \pm 9.3 \times 1^{2}$ *a	$1.5 \times 10^{3} \pm 5.7 \times 10^{2}$ *a	®	$3.7 \times 10^{4} \pm 3.7 \times 10^{3}$ **ab	$1.3 \times 10^{3} \pm 5.7 \times 10^{*}$a	®	ND	ND
14	®	$2.9 \times 10^{5} \pm 2.9 \times 10^{4}$ *a	$4.6 \times 10^{4} \pm 5.3 \times 10^{3}$ *a	®	$4.8 \times 10^{4} \pm 3.3 \times 10^{2}$ **ab	$1.5 \times 10^{4} \pm 1.4 \times 10^{3}$ *ab	®	ND	ND
18	®	$4.7 \times 10^{5} \pm 4 \times 10^{4}$ *a	$7.2 \times 10^{4} \pm 6.3 \times 10^{3}$ *a	®	$8.5 \times 10^{4} \pm 7.1 \times 10^{3}$ *b	$5 \times 10^{4} \pm 1.7 \times 10^{3}$ *bc	®	ND	ND
22	®	$1.3 \times 10^{6} \pm 5.7 \times 10^{4}$ *a	$5.6 \times 10^{5} \pm 1.2 \times 10^{4}$ *a	®	$1.4 \times 10^{5} \pm 3.3 \times 10^{4}$ c	$7.7 \times 10^{4} \pm 8.2 \times 10^{3}$ c	®	ND	ND
26	®	$6.1 \times 10^{7} \pm 3.5 \times 10^{5}$ *b	$3.4 \times 10^{6} \pm 7.5 \times 10^{5}$ *a	®	$8.4 \times 10^{5} \pm 2.9 \times 10^{4}$ *d	$1.5 \times 10^{5} \pm 2.1 \times 10^{4}$ *d	®	ND	ND
30	®		$4.7 \times 10^{7} \pm 3.4 \times 10^{6}$ b	®	®	$1 \times 10^{6} \pm 3.3 \times 10^{4}$ e	®	®	ND

ND Not detected ® rejected

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing → a- e increasing ↑ * significant

Fig.(1): Effect of gamma irradiation on total viable bacterial count of *O. niloticus* flesh during cold storage at 4˚C±1:

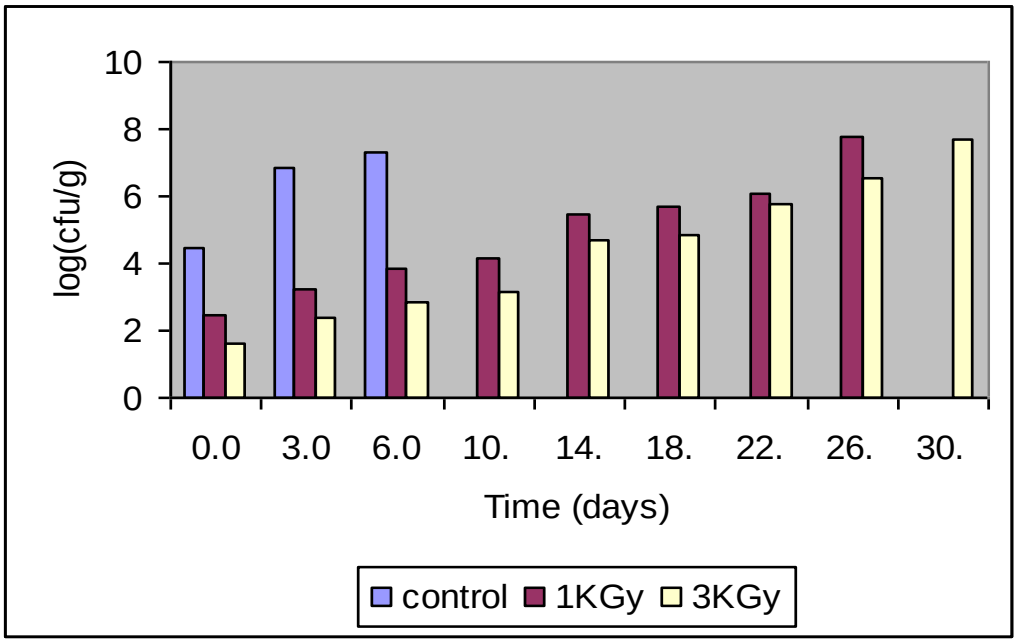


Fig.(2): Effect of gamma irradiation on Psychrophillic bacterial count of *O. niloticus* flesh during cold storage at 4˚C±1:

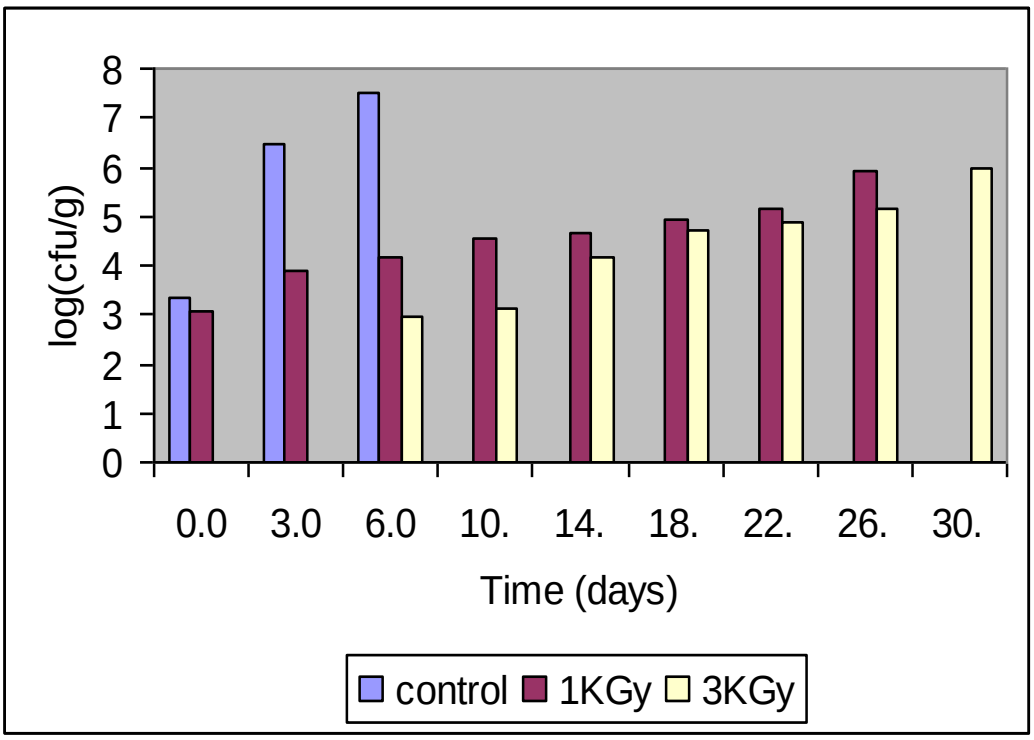
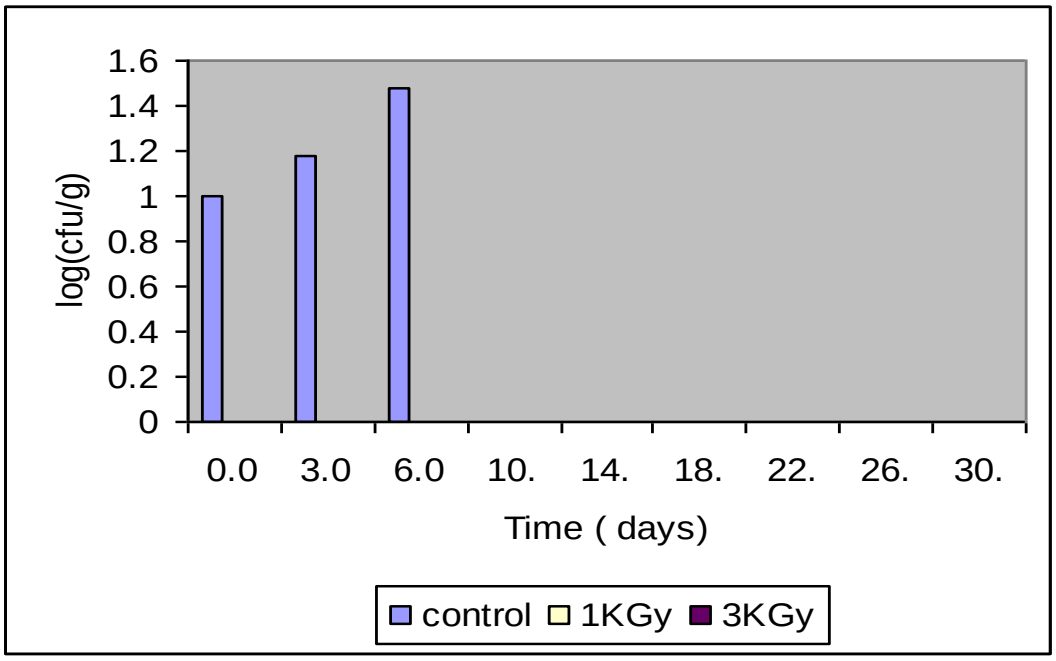


Fig.(3) Effect of gamma irradiation on total yeast and mould count of *O. niloticus* flesh during cold storage at 4˚C±1:



3. 2. Effect of gamma irradiation on the count of Enterococci, Staphylococci and *Bacillus cereus* of *O. niloticus* flesh during cold storage at 4˚C±1:

Data in table (6) and fig (4,5,6) indicated that 1 and 3 kGy initially eliminated Staphylococci and *Bacillus cereus* . However, Enterococci showed some resistance to irradiation than Staphylococci and *Bacillus cereus* which non significantly decreased from $4.8x10^{2} \pm 3.4$ x10 cfu/g. for control sample to 63 ±3.3 cfu/g. When subjected to irradiation dose at 1 kGy while 3 kGy eliminate Enterococci. During storage Enterococci, Staphylococci and *Bacillus cereus* increased gradually in the control samples reaching $1.6x10^{6} \pm 1.1 \text{ x}10^{5}$, $1.2x10^{4} \pm 1.1x10^{3}$ and $3.5x10^{5} \pm 1.1x10^{4}$ cfu/g. respectively at the end of storage period (6 days) which the control samples rejected by the panelist . Meanwhile Staphylococci did not appear in samples received 1and 3 kGy during the cold storage period. however *Bacillus cereus* appeared after 6 and 14 days in samples irradiated at 1 and 3 kGy respectively and become 33 ±0.00 and 16 ±1.2x10 cfu/g. at zero time respectively and increased gradually significantly during the cold storage period and reached $1x10^{4} \pm 6.6x10^{2}$,$8.5x10^{2} \pm 3.3$ cfu/g. respectively after 26 and 30 days of cold storage, similarly the count of Enterococci was significant increased reached to $8.6x10^{5} \pm 8.3x10^{4}$ and $3x\ 10^{4} \pm 1.1\ x10^{3}$ cfu/g., after 26 and 30 days of cold storage in irradiated samples with 1 and 3kGy respectively .

It should be mentioned that all the treated and untreated samples were found to be free from *salmonella* and yeast.

Table(6) Effect of gamma irradiation on the Enterococci, Staphylococci and *Bacillus cereus* (cfu/g) counts of *O. niloticus* flesh during cold storage at 4˚C±1:

torage period days)	Enterococci			Staphylococci			*Bacillus cereus*		
	control	1KGy	3KGy	control	1KGy	3KGy	control	1KGy	3KG
ro time	$4.8 \times 10^{2} \pm 3.4 \times 10^{Aa}$	$6.3 \times 10 \pm 3.3^{Ba}$	$ND \pm 0.00^{Ba}$	$5.6 \times 10^{2} \pm 5.7^{Aa}$	ND	ND	$3.8 \times 10^{2} \pm 2.3 \times 10^{Aa}$	$ND \pm 0.00^{Ba}$	ND ±0.00
3	$4 \times 10^{4} \pm 1.1 \times 10^{3\ Aa}$	$3.9 \times 10^{2} \pm 2.0 \times 10^{Ba}$	$ND \pm 0.00^{Ba}$	$4.3 \times 10^{3} \pm 4 \times 10^{2\ Ab}$	ND	ND	$1.1 \times 10^{4} \pm 5.7 \times 1^{2\ Aa}$	$ND \pm 0.00^{Ba}$	ND ±0.00
6	$1.6 \times 10^{6} \pm 1.1 \times 10^{5\ Ab}$	$5.3 \times 10^{2} \pm 5.2 \times 10^{Ba}$	$6.6 \times 10 \pm 6.6^{Ba}$	$1.2 \times 10^{4} \pm 1.1 \times 10^{3\ Ac}$	ND	ND	$3.5 \times 10^{5} \pm 1.1 \times 10^{4\ Ab}$	$3.3 \times 10 \pm 3.3^{Ba}$	ND ±0.00
10	®	$8.6 \times 10^{2} \pm 1.8 \times 10^{*a}$	$5.6 \times 10 \pm 6.6^{**a}$	®	ND	ND	®	$1.6 \times 10 \pm 0.00^{*a}$	ND ±0.00
14	®	$3.7 \times 10^{3} \pm 1.6 \times 10^{2\ a}$	$2.1 \times 10^{2} \pm 4.9 \times 10^{a}$	®	ND	ND	®	$1.4 \times 10^{2} \pm 1.5 \times 10^{*a}$	1.6x1 ±1.2x1
18	®	$2.7 \times 10^{4} \pm 7.8 \times 10^{3\ *a}$	$1 \times 10^{3} \pm 2.4 \times 10^{2\ a}$	®	ND	ND	®	$3.6 \times 10^{2} \pm 4.1 \times 10^{*a}$	3.5 x1 ±2.4
22	®	$2.5 \times 10^{5} \pm 5.7 \times 10^{4\ *b}$	$2.3 \times 10^{3} \pm 4 \times 10^{2\ *a}$	®	ND	ND	®	$1.7 \times 10^{3} \pm 8.8 \times 10^{**b}$	7.5 x1 ±3.7x1
26	®	$8.6 \times 10^{5} \pm 8.3 \times 10^{4\ *c}$	$1.6 \times 10^{4} \pm 3.4 \times 10^{3\ *a}$	®	ND	ND	®	$1 \times 10^{4} \pm 6.6 \times 10^{2\ *c}$	2.6 x1 ±3.3
30	®	®	$3 \times 10^{4} \pm 1.1 \times 10^{3\ b}$	®	®	ND	®	®	8.5x10 ± 3.3

ND Not detected ® rejected

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing → a-e increasing ↑ * significant

Fig.(4): Effect of gamma irradiation on Enterococci count of *O. niloticus* flesh during cold storage at 4˚C±1:

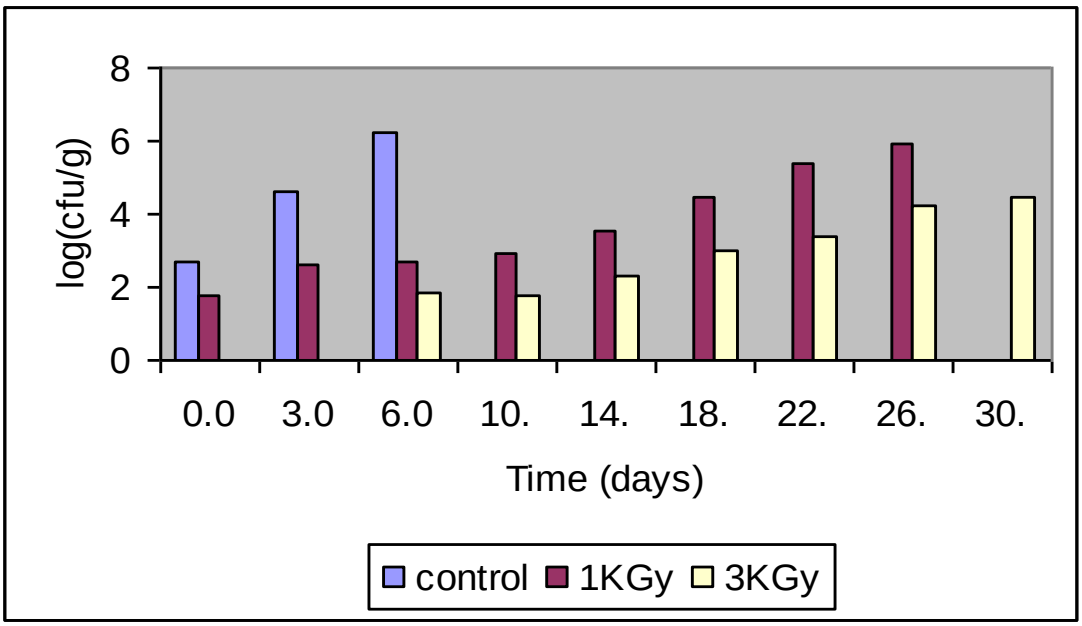


Fig.(5): Effect of gamma irradiation on Staphylococci count of *O. niloticus* flesh during cold storage at 4˚C±1:

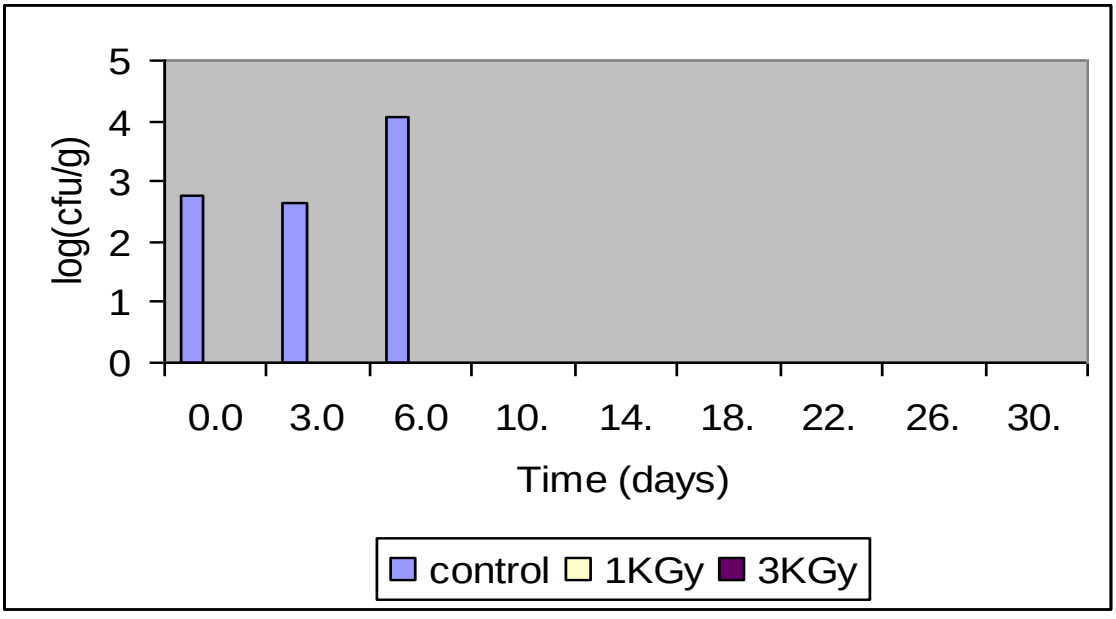
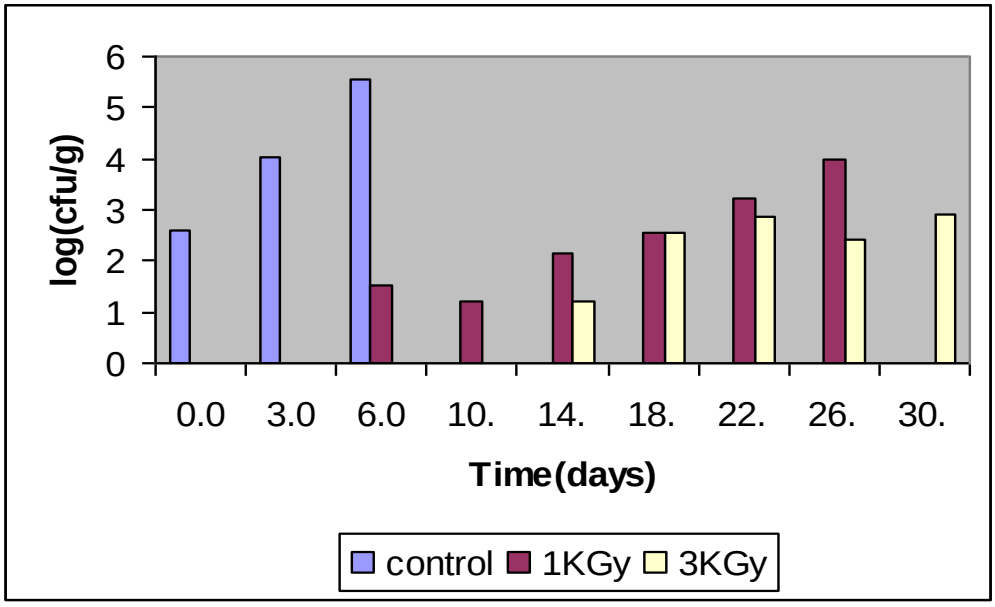


Fig.(6): Effect of irradiation on *Bacillus cereus* count of *O. niloticus* flesh during cold storage at 4˚C±1:



3.3. Effect of gamma irradiation on the chemical properties of *O. niloticus* flesh during cold storage at 4˚C±1:

The effect of gamma irradiation at dose 1 and 3 kGy on the moisture content was shown in table (7) and fig (7). It could be noticed that moisture content of the control was 81.98% ±0.01 at zero time and significantly decreased to 76.7 ±0.02% at the end of cold storage period (6 days). From the same table it could be noticed that moisture content of fish samples decreased significantly after irradiation from 81.98% ±0.01 for control to 79.95 ±0.04% and 79.19 ±0.21% for irradiated fish samples at doses 1 and 3kGy respectively. During cold storage period the moisture content of irradiated samples decreased significantly as the irradiation dose and storage time increased and reached to 74.61 ±0.03% and 73.97 ±0.02% respectively after 26 and 30 days of cold storage, respectively.

Data presented in table (7) and fig (8) represented the pH value of untreated fish samples (control) and treated fish samples with 1 and 3 kGy. It could be noticed that the pH value of the control fish samples was about 6.45 ±0.01, while the pH value of irradiated fish samples were significantly decreased 6.11 ±0.01 and 6.17 ±0.02 after using 1 and 3kGy respectively. These values increased significantly with increasing the storage period and reached to 7.23 ±0.02 and 7.12 ±0.05 respectively after 26 and 30 days of cold storage period respectively.

Table (7) Effect of gamma irradiation on the moisture content and pH of *O. niloticus* flesh during cold storage at 4˚C±1:

Storage period (Days)	**Moisture content%**			**pH**		
	control	1kGy	3kGy	control	1kGy	3kGy
Zero time	81.98 ±0.01^{Ac}	79.95 ±0.04^{Bf}	79.19 ±0.21^{Cd}	6.45 ±0.01^{Aa}	6.11 ±0.01^{Ba}	6.17 ±0.02^{Ca}
3	79.57 ±0.02^{Ab}	77.31 ±0.14^{Be}	77.01 ±0.00^{Cc}	6.71 ±0.00^{Ab}	6.12 ±0.00^{Ba}	6.22 ±0.00^{Ca}
6	76.7 ±0.02^{Aa}	76.44 ±0.02^{Bd}	75.95 ±0.01^{Cb}	6.97 ±0.00^{Ac}	6.38 ±0.01^{Bb}	6.50 ±0.01^{Cb}
10	®	75.58 ±0.15^{c}	74.27 ±0.14^{a}	®	6.60 ±0.01^{c}	6.60 ±0.00^{c}
14	®	75.32 ±0.09^{*cb}	74.52 ±0.09^{*a}	®	6.80 ±0.01^{*d}	6.69 ±0.01^{*d}
18	®	75.46 ±0.14^{*cb}	75.42 ±0.61^{*a}	®	6.88 ±0.00^{*e}	6.83 ±0.01^{*e}
22	®	75.16 ±0.03^{*b}	74.57 ±0.05*^{a}	®	7.01 ±0.01^{*f}	6.85 ±0.03^{*e}
26	®	74.61 ±0.03^{*a}	74.24 ±0.10^{*a}	®	7.23 ±0.02^{*g}	6.93 ±0.03^{*f}
30	®	®	73.97 ±0.02*^{a}	®	®	7.12 ±0.05^{g}

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing → a- g increasing ↑ * significant ® **Rejected**

Fig.(7): Effect of gamma irradiation on moisture content of *O. niloticus* flesh during cold storage at 4˚C±1:

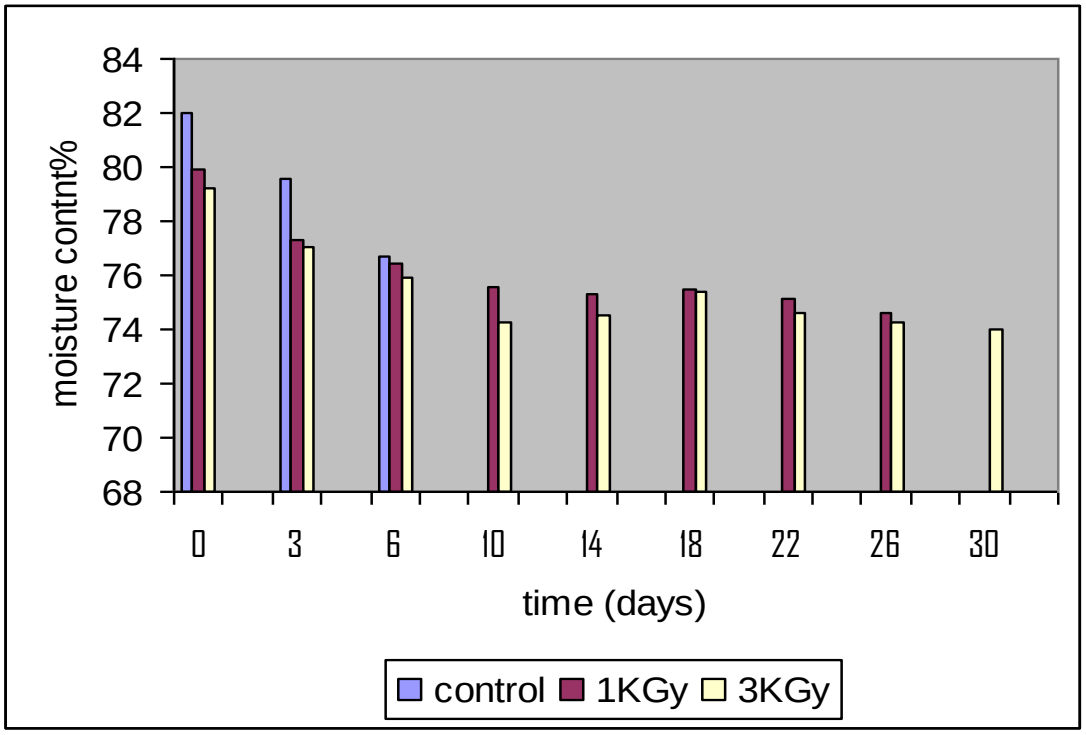
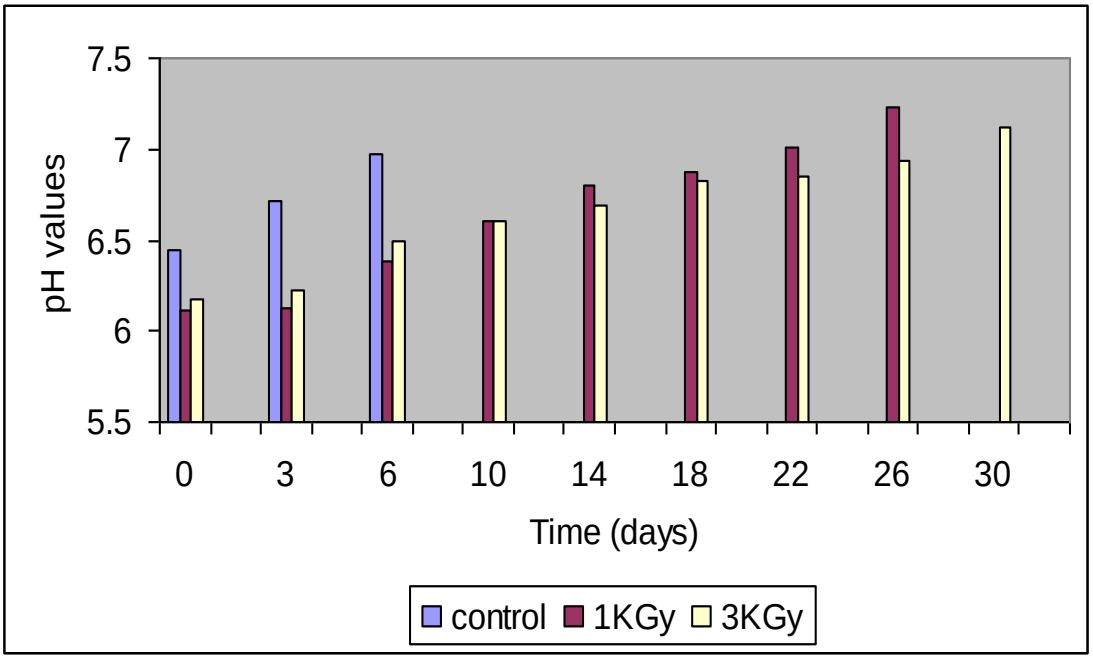


Fig.(8): Effect of gamma irradiation on pH value of *O. niloticus* flesh during cold storage at 4˚C±1:



The data represented in table (8) and fig (9) showed that total volatile basic nitrogen (TVBN) of control fish samples was 8.48 ±0.21 mgN/100g. at zero time. While TVBN increased significantly to 9.28 ±0.00, 9.87 ±0.03 mg.N/100g by exposing fish samples to the ascending dose of gamma irradiation 1 and 3 kGy respectively. During storage the amount of TVBN continuously increased in all samples undertaken but the unirradiatied samples recorded the highest values that of irradiated ones. The TVBN of the control sample reached to 26.57 ±0.51 mg.N/100g at the end of the storage period (6 days). Meanwhile, the TVBN of irradiated fish samples exposed to 1 and 3 kGy reached to 32.55 ±0.45 and 30.57 ±0.08 mg.N/100g respectively at the end of the storage period after 26, 30 days respectively.

The same table and fig (10) represented that the thiobarbituric acid TBA value of control fish samples was 0.014 ±0.00 OD at zero time of storage period meanwhile this value showed a gradual significant increase with increasing gamma irradiation dose as it increased from 0.014 ±0.00in control sample to 0.026 ±0.00 and 0.035 ±0.00 OD after exposed fish samples to 1 and 3 kGy respectively. The value of TBA increased gradually in control samples from 0.014 ±0.00 to 0.073 ±0.00 after 6 days of cold storage while the rate of increasing was higher in irradiated samples where the value of TBA increased significantly to 0.320 ±0.00 and 0.424 ±0.00 in samples received 1 and 3 kGy respectively at the end of cold storage period.

Table (8) Effect of gamma irradiation on TVBN (mg.N/100g) and TBA (OD at λ_{max}538) of *O. niloticus* flesh during cold storage at 4˚C±1:

Storage period (Days)	TVBN			TBA		
	control	1kGy	3kGy	control	1kGy	3kGy
Zero time	8.48 ±0.21^{Aa}	9.28 ±0.00^{Ba}	9.87 ±0.03^{Ca}	0.014 ±0.00^{Aa}	0.026 ±0.00^{Ba}	0.035 ±0.00^{Ca}
3	18.53 ±0.23^{Ab}	13.48 ±0.07^{Bb}	14.26 ±0.14^{Cb}	0.042 ±0.00^{Ab}	0.045 ±0.00^{Bb}	0.056 ±0.00^{Ba}
6	26.57 ±0.51^{Ac}	15.87 ±0.08^{Bc}	17.58 ±0.25^{Cc}	0.073 ±0.00^{Ac}	0.082 ±0.00^{Bc}	0.089 ±0.00^{Bb}
10	®	19.04 ±0.08^{*d}	20.18 ±0.14^{*d}	®	0.113 ±0.01^{*d}	0.119 ±0.00^{*c}
14	®	21.16 ±0.10^{*e}	22.05 ±0.32^{*e}	®	0.140 ±0.00^{*e}	0.162 ±0.00^{*d}
18	®	22.26 ±0.08^{**f}	23.71 ±0.14^{**f}	®	0.223 ±0.00^{**f}	0.292 ±0.00^{**e}
22	®	25.84 ±0.07^{*g}	25.44 ±0.10^{*g}	®	0.265 ±0.00^{*g}	0.388 ±0.02^{*f}
26	®	32.55 ±0.45^{*h}	29.47 ±0.08^{*h}	®	0.320 ±0.00^{**h}	0.391 ±0.00^{**g}
30	®	®	30.57 ±0.08^{i}	®	®	0.424 ±0.00^{h}

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing → a- i increasing ↑ * significant

Fig.(9): Effect of gamma irradiation on TVBN(mg.N/100g) value of *O. niloticus* flesh during cold storage at 4˚C±1:

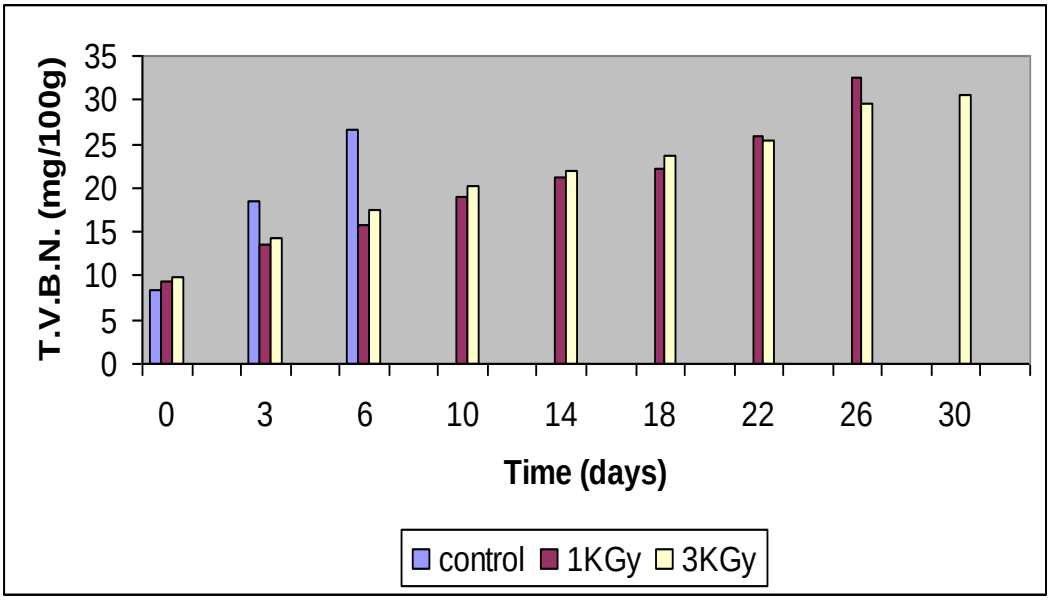
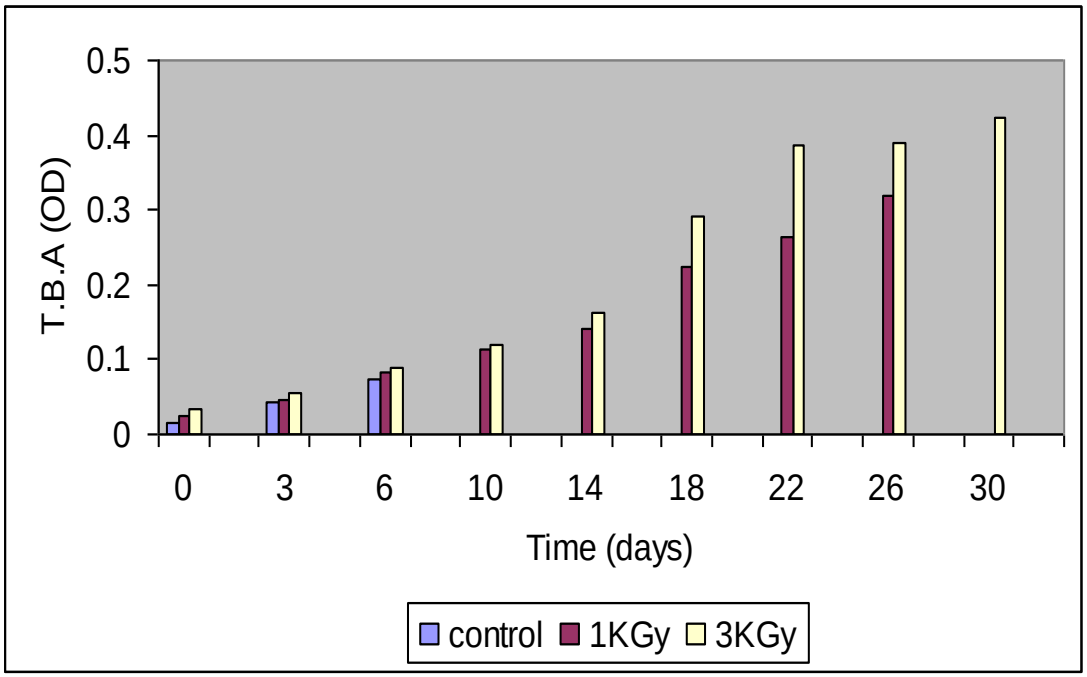


Fig.(10): Effect of gamma irradiation on TBA (OD at λ_{max}538) value of *O. niloticus* flesh during cold storage at 4˚C±1:



4. Effect of potassium sorbate on the microbial load and chemical properties of *O. niloticus* flesh during cold storage at 4°C ±1 :

4.1 Effect of potassium sorbate on the total viable bacterial count, psychrophillic bacteria and total yeast and mould of *O. niloticus* flesh during cold storage 4°C ±1:

Data in table (9) and fig (11,12,13) indicated that the intial bacterialviable count, Psychrophillic bacteria and total yeast and mould in control fish sample were $2.7 \times 10^4 \pm 2.3 \times 10^3$, $2.2 \times 10^4 \pm 1.1 \times 10^3$, 10 ± 0.00 cfu/g respectively.

From the same table it could be noticed that, a significant gradual increase in the total viable count and Psychrophillic bacteria of the control fish sample, were observed during cold storage and reached $2.2 \times 10^7 \pm 1.7 \times 10^6$, $3.3 \times 10^7 \pm 5.7 \times 10^6$ cfu/g respectively after 6 days. the total yeast and mould reached to 30 ± 5.7 cfu/g after 6 days.

It could be observed that there was a significant reduction in the total viable bacterial count, psychrophillic bacteria and total yeast and mould after dipping in potassium sorbate (K.sorbate) solution reached to $2 \times 10^4 \pm 5.7 \times 10^2$ and $1.4 \times 10^4 \pm 5.7 \times 10^2$ cfu/g for the total viable count after dipping in 1% and 2% w/v K.sorbate solution respectively and $1.4 \times 10^3 \pm 5.7 \times 10$and $1 \times 10^2 \pm 2.9$ cfu/g for psychrophillic bacteria after dipping in 1 % and 2 % w/v K.sorbate solution , respectively and 5 ± 2.8 for the total yeast and mould after dipping in 1% K. sorbate while were undetected after using 2% K.sorbate solution.

During cold storage, the total bacterial count which affected with 1% and 2% w/v K.sorbate increased significantly from $2 \times 10^4 \pm 5.7 \times 10^2$, $1.4 \times 10^4 \pm 5.7 \times 10^2$ cfu/g respectively at zero time to $1.3 \times 10^7 \pm 5.7 \times 10^5$ and $1.2 \times 10^7 \pm 1 \times 10^6$ cfu/g after 10 and 14 days of cold storage period respectively. The same was noticed in the Psychrophillic bacteria which affected with 1 and 2% Potassium K.sorbate increased significantly reached $1.4 \times 10^6 \pm 1.7 \times 10^5$, $7.6 \times 10^6 \pm 5.7 \times 10^5$ cfu/g after 10 and 14 days of cold storage period respectively.

During cold storage period the total yeast and mould count for the treated sample with 1% and 2% Potassium sorbate were not detected during the storage period.

Table (9) Effect of potassium sorbate on the total viable bacterial count, psychrophillic bacteria and total yeast and mould (cfu/g) of *O. niloticus* flesh during cold storage at 4˚C±1:

Storage period (Days)	Total viable bacterial count			Psychrophillic bacteria			Total yeast and mould		
	control	K.Sorbate 1%	K.Sorbate 2%	control	K.Sorbate 1%	K.Sorbate 2%	control	K.Sorbate 1%	K.Sorbate 2%
Zero time	$2.7x10^{4}$ $\pm 2.3x10^{3}$ Aa	$2x10^{4}$ $\pm 5.7x10^{2}$ Ba	$1.4x10^{4}$ $\pm 5.7x10^{2}$ Ca	$2.2x10^{4}$ $\pm 1.1x10^{3}$ Aa	$1.4x10^{3}$ $\pm 5.7x10^{Ba}$	$1x10^{2}$ $\pm 2.9^{Ba}$	10 $\pm 0.00^{Aa}$	5 $\pm 2.8^{Ba}$	ND $\pm 0.00^{Ba}$
3	$7.2x10^{6}$ $\pm 1.4x10^{5}$ Ab	$2.2x10^{5}$ $\pm 5.7x10^{2}$ Ba	$2x10^{3}$ $\pm 1.7x10^{2}$ Ba	$2.8x10^{6}$ $\pm 2.3x10^{5}$ Ab	$2.5x10^{4}$ $\pm 2.3x10^{3}$ Ba	$3.4x10^{3}$ $\pm 2.8x10^{2}$ Ba	15 $\pm 2.8^{Aa}$	ND $\pm 0.00^{Ba}$	ND $\pm 0.00^{Bb}$
6	$2.2x10^{7}$ $\pm 1.7x10^{6}$ Ac	$1.3x10^{6}$ $\pm 1.7x10^{4}$ Ba b	$5.2x10^{5}$ $\pm 2.5x10^{4}$ Ba	$3.3x10^{7}$ $\pm 5.7x10^{6}$ Ac	$1.7x10^{5}$ $\pm 1.7x10^{4}$ Ba	$3.5x10^{3}$ $\pm 1.3x10^{2}$ Ba	30 $\pm 5.7^{Aa}$	ND $\pm 0.00^{Ba}$	ND $\pm 0.00^{Bc}$
10	®	$1.3x10^{7}$ $\pm 5.7x10^{5}$ *b	$2.5x10^{6}$ $\pm 1.1x10^{5}$ *b	®	$1.4x10^{6}$ $\pm 1.7x10^{5}$ *b	$4.8x10^{5}$ $\pm 2.1x10^{4}$ *b	®	ND $\pm 0.00^{*a}$	ND $\pm 0.00^{*d}$
14	®	®	$1.2x10^{7}$ $\pm 1x10^{6}$ c	®	®	$7.6x10^{6}$ $\pm 5.7x10^{5}$ c	®	®	ND $\pm 0.00^{e}$

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing → a- e increasing ↑ * significant

® Rejected

Fig.(11): Effect of potassium sorbate on the total viable bacterial count of *O. niloticus* flesh during cold storage 4°C ±1:

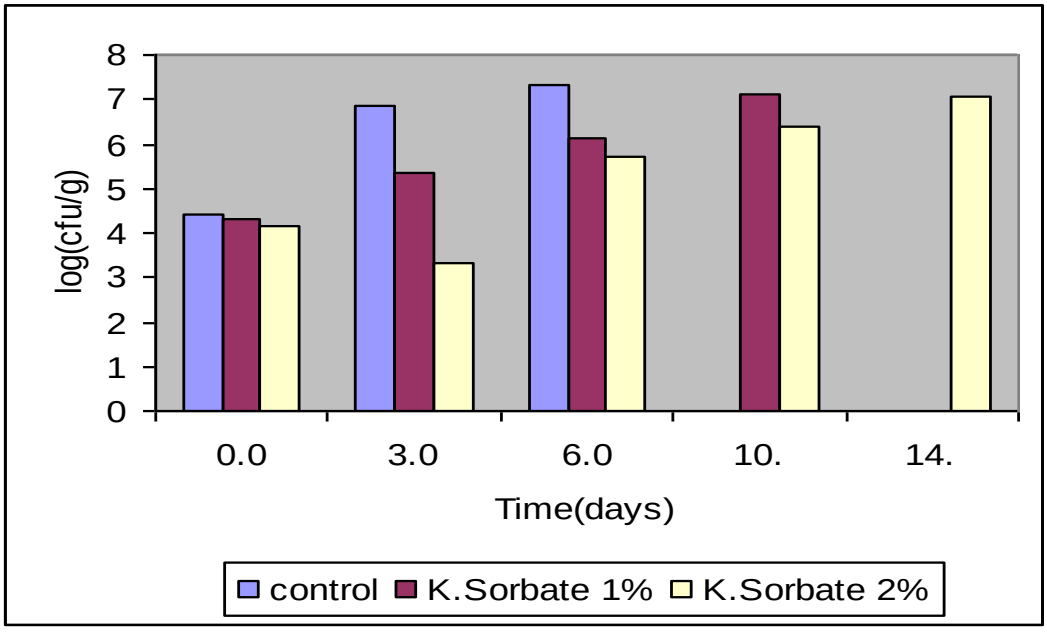


Fig.(12): Effect of potassium sorbate on the Psychrophillic bacteria of *O. niloticus* flesh during cold storage 4°C ±1:

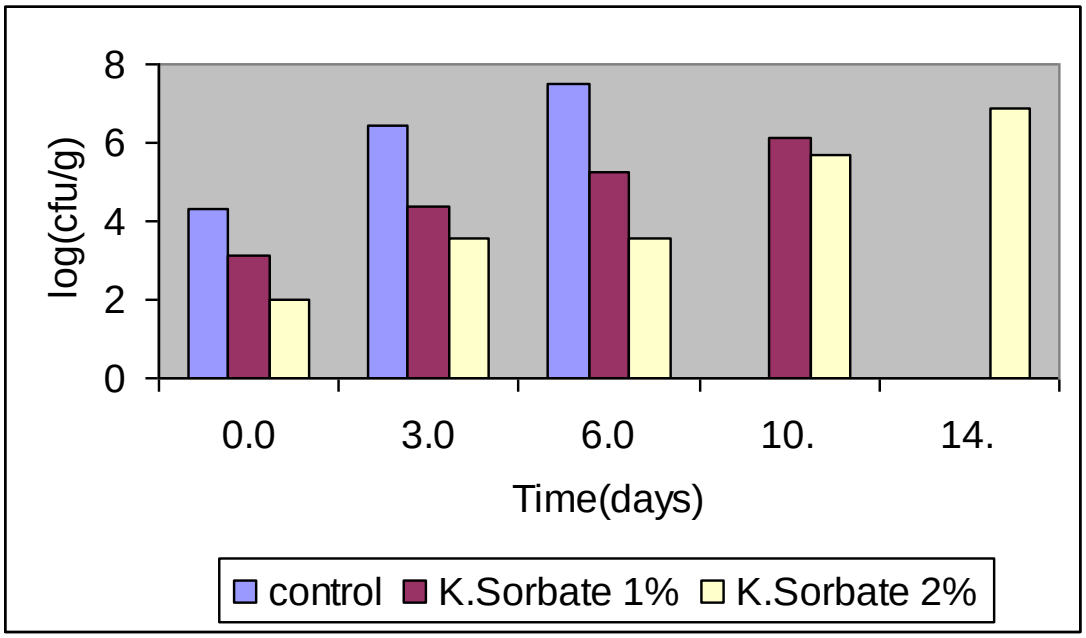
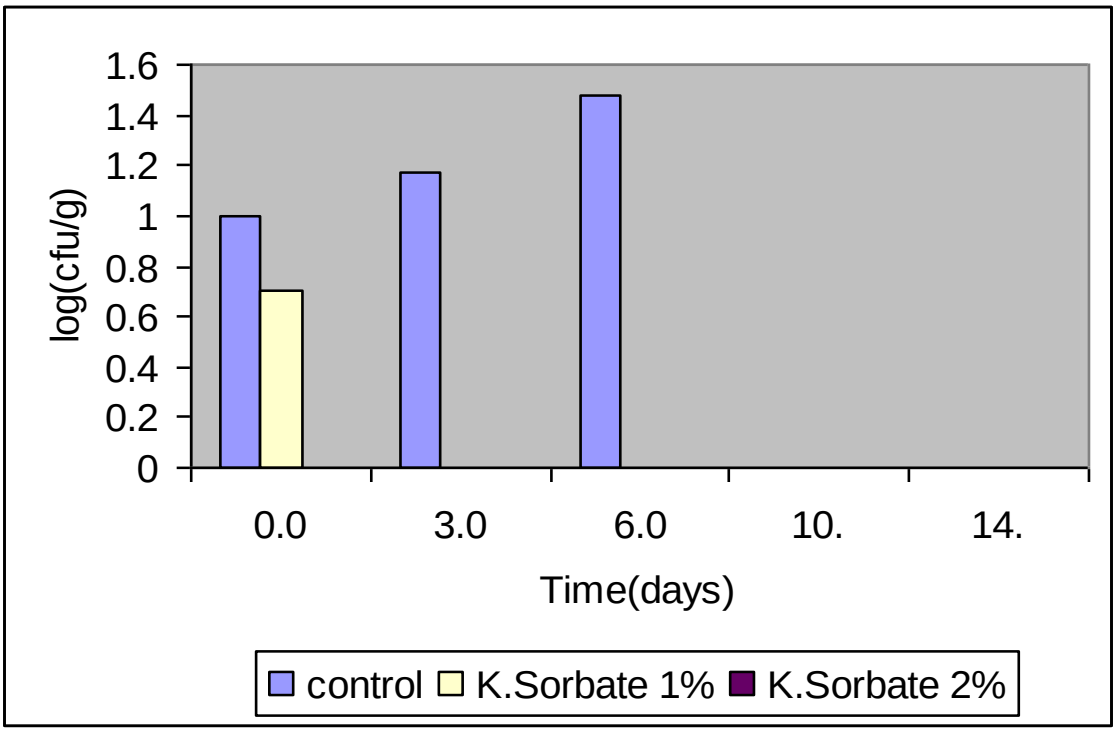


Fig.(13): Effect of potassium sorbate on the yeast and mould of *O. niloticus* flesh during cold storage 4°C ±1:



4.1.2 Effect of Potassium sorbate on Enterococci, staphylococci and *Bacillus cereus* counts of *O. niloticus* flesh during cold storage at 4˚C±1:

Data presented in table (10) and fig(14,15,16) indicated that the initial count of Enterococci, Staphylococci and *Bacillus cereus*, in control fish samples were 4.8 x 10^2 ±3.4x10, 5.6 x 10^2 ±5.7 , 3.8 x 10^2 ±23 cfu/g respectively.

The table indicated also that there was a significant increase in Enterococci, Staphylococci and *Bacillus cereus* count of the control fish samples during cold strorage reached to 1.6 x 10^6 ±1.1x10^5; 1.2 x 10^4 ±1.1x10^3 and 3.5 x 10^5 ±1.1x10^4 cfu/g respectively after 6 days.

Data presented in table (10) showed the count of Enterococci, Staphylococci and *Bacillus.cereus* of fish flesh samples was affected by the dipping on K.sorbate.solution The intial count of Enterococci for control fish was 4.8 x 10^2 ±3.4x10 cfu/g then significantly decreased after dipping in 1 and 2% w/v Potassium sorbate solution to 4 x 10^2 ±5.7 , 2.3 x 10^2 ±17 cfu/g respectively at zero time, and the intial count of Staphylococci of control fish sample was 5.6 x 10^2 ±5.7 cfu/g then significantly decreased after dipping in 1 and 2% Potassium sorbate to 4.6 x 10^2 ±10 and 1.3 x 10^2 ±5.7cfu/g respectively and the same in the intial count of *Bacillus.cereus* of control fish sample was 3.8 x 10^2 ±23cfu/g then significantly decreased after dipping in 1 and 2% Potassium sorbate to 2.6 x 10^2 ±17, 1.4 x 10^2 ±5.7 cfu/g respectively.

It could be noticed that there was a significant increase in the total count of Enterococci, for sample treated with 1% and 2% w/v Potassium sorbate solution from 4x 10^2 ±5.7 and 2.3 x 10^2 ±17 cfu/g respectively at zero time to 7.6 x 10^5 ±6.6x10^3 and 9.7 x 10^5 ±1.1x10^3 cfu/g after 10 and 14 days of cold storage period respectively. The count of Staphylococci which affected with 1% and 2% w/v Potassium sorbate increased significantly from 4.6 x 10^2 ±10 and 1.3 x 10^2 ±5.7cfu/g respectively at zero time and reached to 4.4 x 10^4 ±8x10^3 and 6.8 x 10^3 ±9.3x10^2cfu/g after 10 and 14 days of cold storage period respectively. The same in the count of *Bacillus.cereus* for fish samples treated

with 1% and 2% w/v Potassium sorbate increased significantly from 2.6 x 10^2 ±17, 1.4 x 10^2 ±5.7cfu/g respectively at zero time to 3.7 x 10^5 ±2.3x10^4, 1.3 x 10^4 ±57 cfu/g after 10 and 14 days of cold storage period respectively.

Table (10) Effect of potassium sorbate on Enterococci, Staphylococci and *Bacillus cereus* counts (cfu/g) of *O. niloticus* flesh during cold storage at 4˚C±1:

Storage period (Days)	Enterococci			Staphylococci			*Bacillus cereus*		
	control	K.Sorbate 1%	K.Sorbate 2%	control	K.Sorbate 1%	K.Sorbate 2%	control	K.Sorbate 1%	K.Sorbate 2%
Zero time	$4.8 \times 10^{2} \pm 3.4 \times 10^{Aa}$	$4 \times 10^{2} \pm 5.7^{Ba}$	$2.3 \times 10^{2} \pm 1.7 \times 10^{Ca}$	$5.6 \times 10^{2} \pm 5.7^{Aa}$	$4.6 \times 10^{2} \pm 1 \times 10^{Ba}$	$1.3 \times 10^{2} \pm 5.7^{Ca}$	$3.8 \times 10^{2} \pm 2.3 \times 10^{Aa}$	$2.6 \times 10^{2} \pm 1.7 \times 10^{Ba}$	$1.4 \times 10^{2} \pm 5.7^{Ca}$
3	$4 \times 10^{4} \pm 1.1 \times 10^{3\ Aa}$	$7 \times 10^{3} \pm 1.7 \times 10^{2\ Bab}$	$1.1 \times 10^{3} \pm 1.3 \times 10^{2\ Ca}$	$4.3 \times 10^{3} \pm 4 \times 10^{2\ Ab}$	$2 \times 10^{2} \pm 1.7 \times 10^{Ba}$	$1.5 \times 10 \pm 1.1^{Ba}$	$1.1 \times 10^{4} \pm 5.7 \times 10^{2\ Ab}$	$9.8 \times 10^{3} \pm 6.6 \times 10^{Ba}$	$5 \times 10^{2} \pm 1.1 \times 10^{Ca}$
6	$1.6 \times 10^{6} \pm 1.1 \times 10^{5\ Ab}$	$1.3 \times 10^{4} \pm 1.1 \times 10^{3\ Bb}$	$2.5 \times 10^{3} \pm 5.7 \times 10^{Ba}$	$1.2 \times 10^{4} \pm 1.1 \times 10^{3\ Ac}$	$9.8 \times 10^{3} \pm 4.7 \times 10^{2\ Ba}$	$1.3 \times 10^{2} \pm 3.3^{Ba}$	$3.5 \times 10^{5} \pm 1.1 \times 10^{4\ Ac}$	$1.7 \times 10^{4} \pm 1.3 \times 10^{3\ Bab}$	$1.4 \times 10^{3} \pm 1.7 \times 10^{2\ Bb}$
10	®	$7.6 \times 10^{5} \pm 6.6 \times 10^{3\ *c}$	$7 \times 10^{4} \pm 2.6 \times 10^{3\ *b}$	®	$4.4 \times 10^{4} \pm 8 \times 10^{3\ **b}$	$1.6 \times 10^{3} \pm 1.1 \times 10^{2\ **b}$	®	$3.7 \times 10^{5} \pm 2.3 \times 10^{4\ **b}$	$3.1 \times 10^{3} \pm 5.7 \times 10^{**c}$
14	®	®	$9.7 \times 10^{5} \pm 1.1 \times 10^{4\ c}$	®	®	$6.8 \times 10^{3} \pm 9.3 \times 10^{2\ c}$	®	®	$1.3 \times 10^{4} \pm 5.7 \times 10^{2\ d}$

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing → a- d increasing ↑ * significant ® **Rejected**

Fig.(14): Effect of potassium sorbate on Enterococci count of *O. niloticus* flesh during cold storage 4°C ±1:

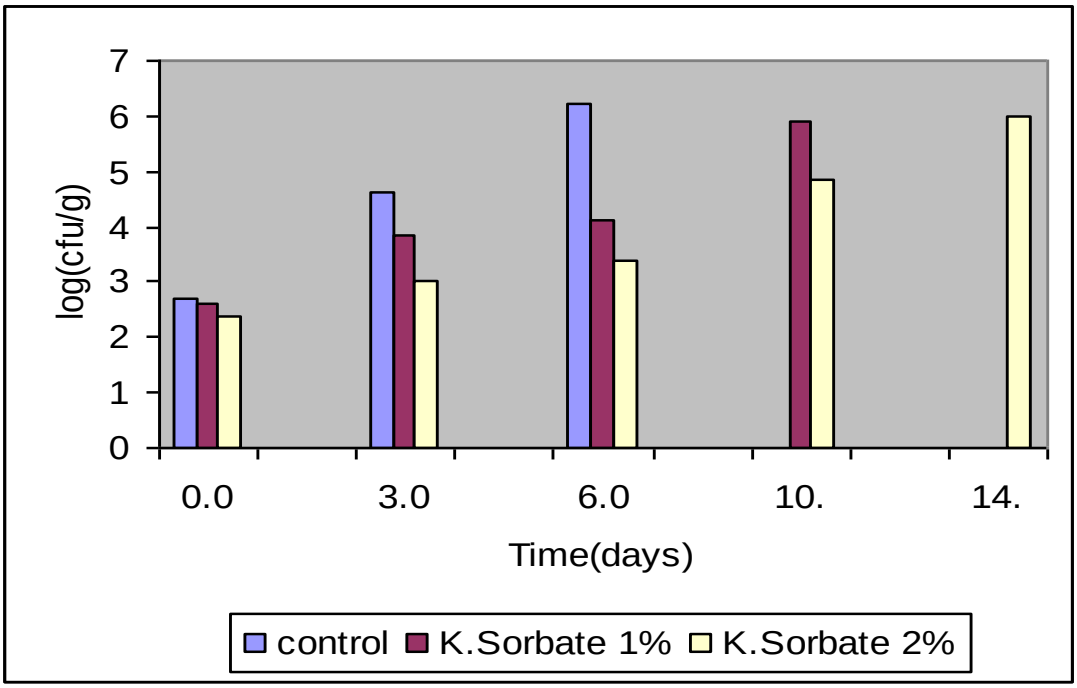


Fig.(15): Effect of potassium sorbate on Staphylococci count of *O. niloticus* flesh during cold storage 4°C ±1:

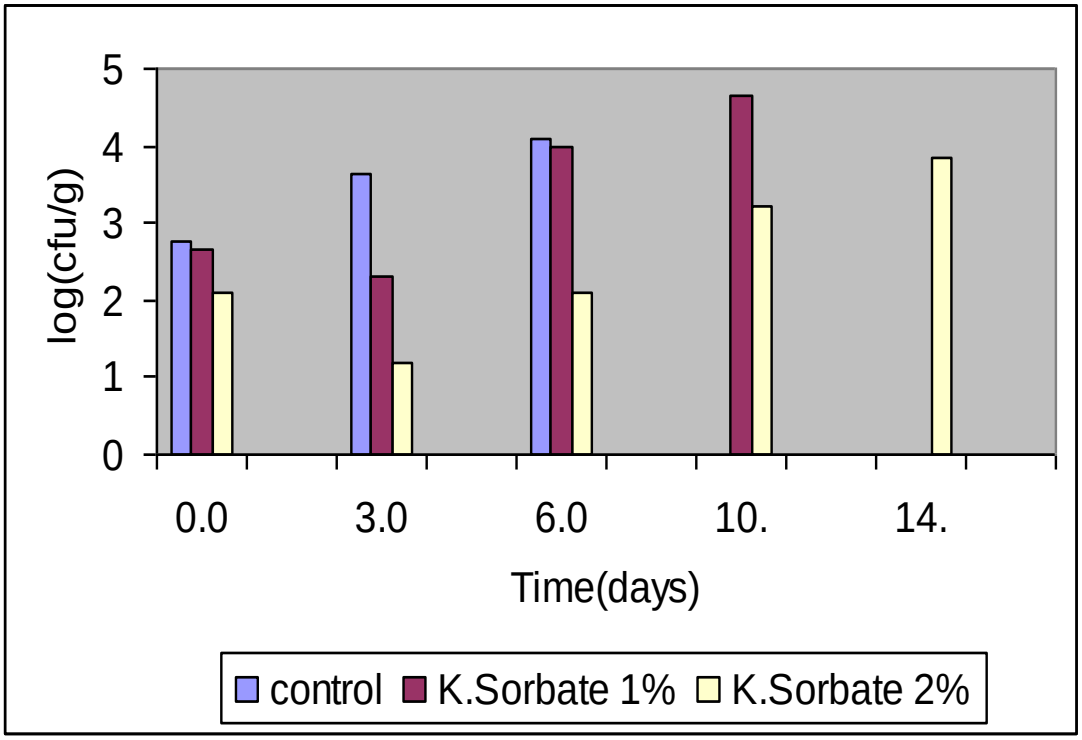
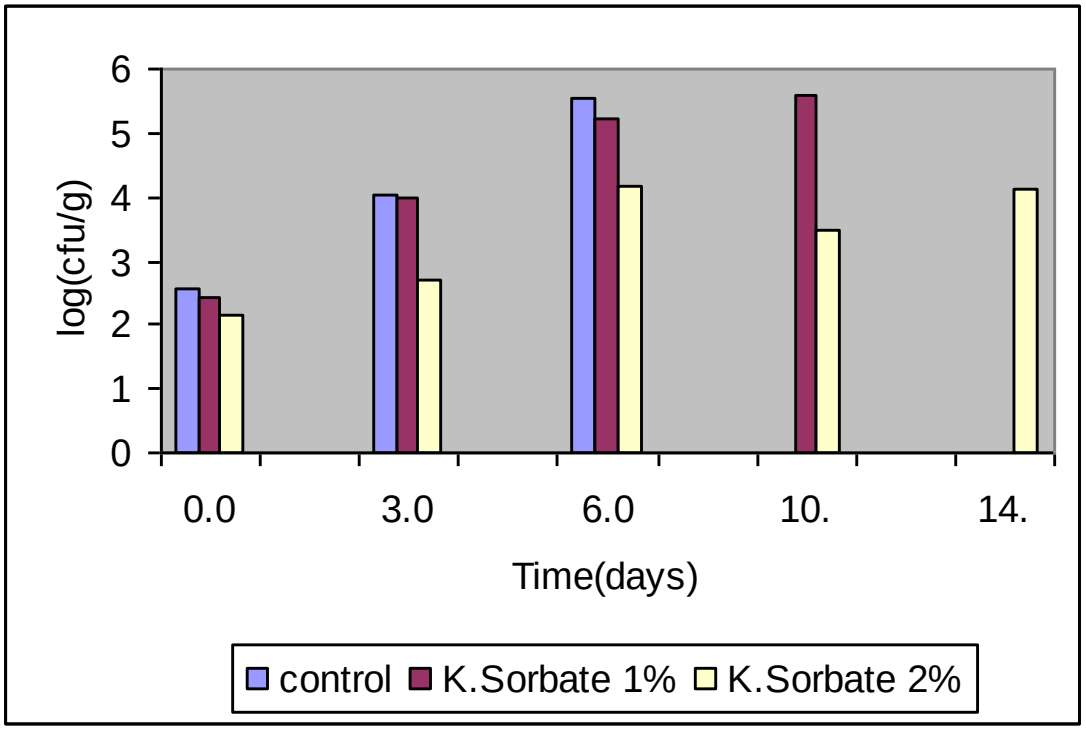


Fig.(16): Effect of potassium sorbate on *Bacillus cereus* count of *O. niloticus* flesh during cold storage 4°C ±1:



4.3 Effect of Potassium sorbate on the chemical properties of *O. niloticus* flesh during cold storage at 4°C±1:

Data in table (11) and fig (17) showed that moisture content of the control samples was 81.98% ±0.01 at zero time of cold storage period and slightly decreased to 76.70% ±0.02 after 6 days of cold storage significant decrease was happened after dipping in 1% and 2% potassium sorbate solutions which were 80.59% ±0.01, 79.22% ± 0.07 respectively. The moisture content of fish samples treated with 1 and 2% Potassium sorbate significant decreased during cold storage from 80.59% ±0.01, 79.22% ±0.07 repectively at zero time to 75.74% ±0.02 , 72.31% ±0.01 respectively after 10,14 days of cold storage.

Data in table (11) and fig (18) indicated that the pH value of control fish flesh samples was 6.45 ±0.01 while that treated with 1% and 2 %w/v k. sorbate were significant increased reached 6.54 ±0.00 and 6.56 ±0.01 respectively at zero time of cold storage. The pH value were significantly increased for control and that treated with 1 and 2%w/v k. sorbate reached to 6.97 ±0.00 , 7.14 ±0.01 and 7.30 ±0.17 respectively at 6, 10 and 14 days of cold storage period.

Table (11) Effect of potassium sorbate on the moisture content% and pH of *O. niloticus* during cold storage at 4˚C±1:

Storage period (Days)	Moisture content%			pH		
	control	K.Sorbate 1%	K.Sorbate 2%	control	K.Sorbate 1%	K.Sorbate 2%
Zero time	81.98 ±0.01^{Ac}	80.59 ±0.01^{Bd}	79.22 ±0.07^{Cd}	6.45 ±0.01^{Aa}	6.54 ±0.00^{Ba}	6.56 ±0.01^{Ba}
3	79.57 ±0.02^{Ab}	77.26 ±0.02^{Bc}	78.41 ±0.01^{Cd}	6.71 ±0.00^{Ab}	6.69 ±0.01^{Bb}	6.67 ±0.00C^{ab}
6	76.70 ±0.02^{Aa}	76.28 ±0.00^{Bb}	76.56 ±0.01^{Cc}	6.97 ±0.00^{Ac}	6.90 ±0.01^{Bc}	6.72 ±0.01^{Cab}
10	®	75.74 ±0.02^{B*a}	73.48 ±0.00^{*c}	®	7.14 ±0.01^{*d}	6.86 ±0.01^{*b}
14	®	®	72.31 ±0.01^{a}	®	®	7.30 ±0.17^{c}

Means carrying different superscripts are significant at ($p \leq 0.05$)
A-C increasing→ a-d increasing ↑ * significant
® rejected

Fig.(17): Effect of potassium sorbate on moisture content of *O. niloticus* flesh during cold storage 4°C ±1:

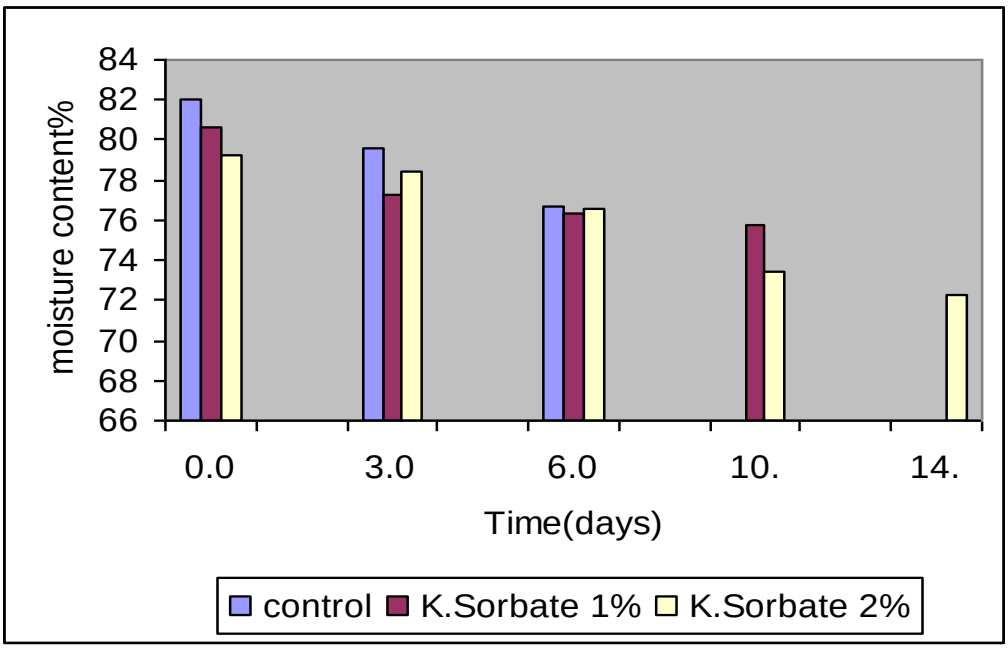
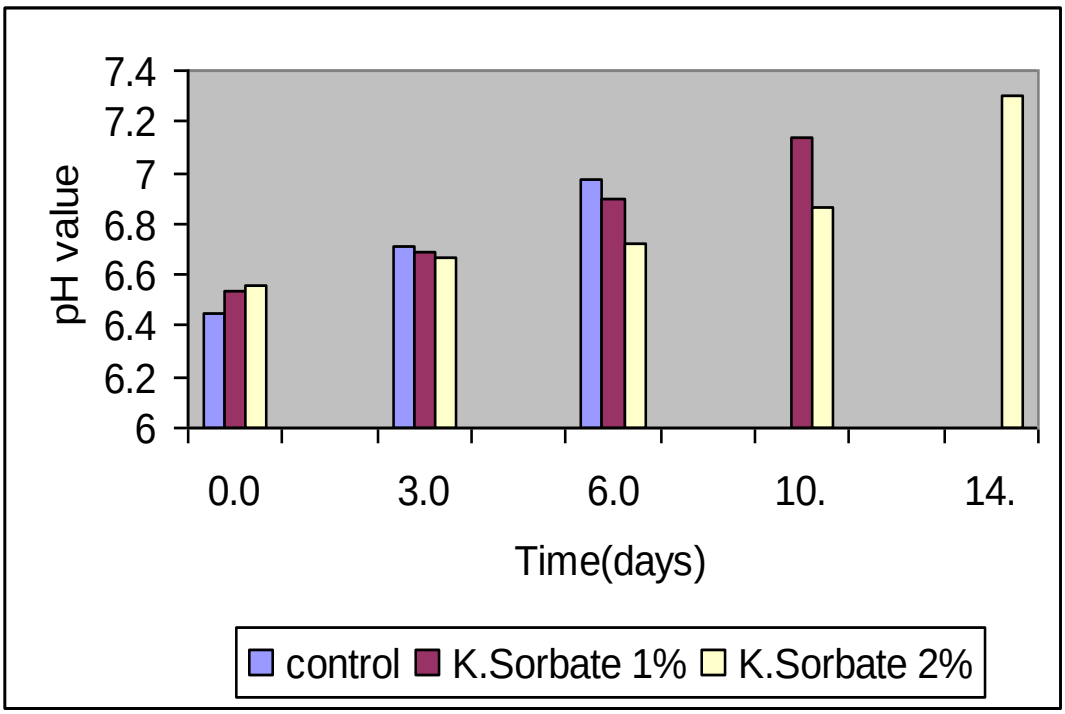


Fig.(18): Effect of potassium sorbate on pH value of *O. niloticus* flesh during cold storage 4°C ±1:



The data represented in table (12) and illustrated by Fig. (19) showed that the TVBN of control (untreated) flesh samples and the treated samples with 1% and 2% w/v K.sorbate were 8.48 ±0.21 , 8.07 ±0.00 , 7.97 ±0.02 mg.N/100g respectively. During cold storage, the amount of TVBN gradually significant increased in all samples undertaken but the control recorded the higher values than those of the samples treated with l% and 2% K.sorbate.

The TVBN of the control and that treated with l% and 2% Potassium sorbate recorded 26.77 ±0.51, 27.92 ±0.01, 31.19 ±0.04mg.N/100g. after 6,10 and 14 days of cold storage period respectively.

Also the data recorded in table (12) and fig (20) represented that TBA. value of control fish samples was 0.014 ±0.00 OD at zero time of storage period, in addition treated with 1 and 2% sorbate solutions had no effect on TBA value of fish samples. The TBA also followed during storage, in the control fish samples, and fish samples treatment with 1% and 2% w/v K.sorbate at 4°C ±1 in which it increased significantly during the cold storage and reached 0.120 ±0.00 , 0.128 ±0.00 and 0.151 ±0.00 OD after 6, 10 and 14 days of cold storage respectively .

.

Table (12) Effect of potassium sorbate on TVBN mg.N/100g and TBA ODλ_{max}538 of *O.niloticus* flesh during cold storage at 4˚C±1::

Storage period (Days)	TVBN			TBA		
	control	K.Sorbate 1%	K.Sorbate 2%	control	K.Sorbate 1%	K.Sorbate 2%
Zero time	8.48 ±0.21^{Aa}	8.07 ±0.00^{ABa}	7.97 ±0.02^{Aa}	0.014 ±0.00^{Aa}	0.013 ±0.00^{Ba}	0.014 ±0.00^{Ca}
3	18.42 ±0.23^{Ab}	9.21 ±0.01^{Bb}	8.17 ±0.03^{Cb}	0.042 ±0.00^{Ab}	0.044 ±0.00A^{Bb}	0.045 ±0.00^{Bb}
6	26.77 ±0.51^{Ac}	18.63 ±0.02^{Bc}	11.60 ±0.01^{Cc}	0.120 ±0.00^{Ac}	0.090 ±0.00^{Bc}	0.111 ±0.00^{Cc}
10	®	27.42 ±0.01^{*d}	21.50 ±0.00^{*d}	®	0.128 ±0.00^{**d}	0.139 ±0.00^{**d}
14	®	®	31.19 ±0.04^{e}	®	®	0.151 ±0.00^{e}

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing→ a-e increasing ↑ * significant ® Rejected

Fig.(19): Effect of potassium sorbate on TVBN mg.N/100g of *O. niloticus* flesh during cold storage 4°C ±1:

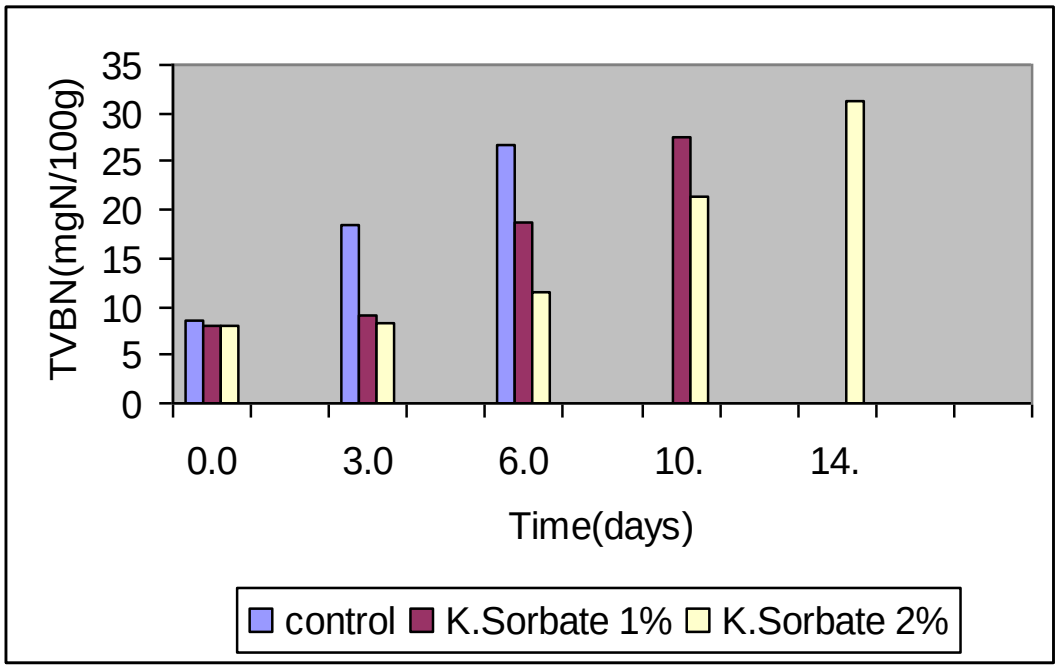
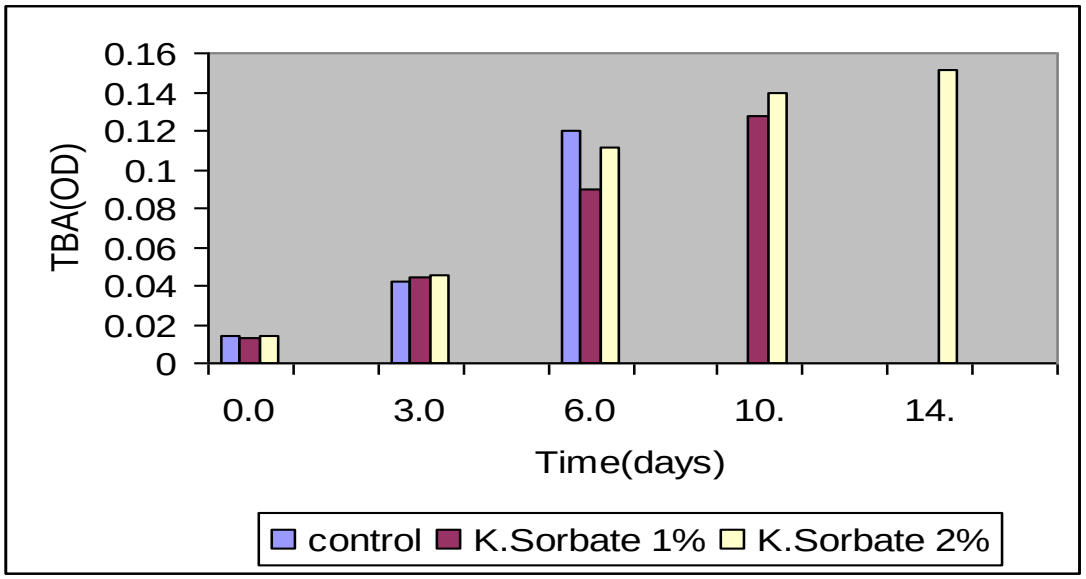


Fig.(20): Effect of potassium sorbate on TBA ODλ_{max}538 of *O. niloticus* flesh during cold storage 4°C ±1:



5. Effect of Mint oil on the microbial load and chemical properties of *O. niloticus* flesh during cold storage at 4°C±1:

5.1 Effect of Mint oil on the total viable bacterial count, Psychrophillic and total yeast and mould of *O. niloticus* flesh during cold storage:

Data in table (13) and fig (21,22,23) indicated that there a significant increase in the total viable bacterial count, psychrophillic bacteria and total yeast and mould, for the control which were $2.7 \times 10^4 \pm 2.3 \times 10^3$, $2.2 \times 10^4 \pm 1.1 \times 10^3$ and 10 ± 0.00 cfu/g respectively and reached to $2.2 \times 10^7 \pm 1.7 \times 10^6$, $3.3 \times 10^7 \pm 5.7 \times 10^6$ and 30 ± 5.7 cfu/g after 6 days of cold storage period.

It could be noticed that treating fish samples with 1 and 2% v/v Mint oil solution caused significant reduction in the initial total count to $1.3 \times 10^4 \pm 1.1$, $1.1 \times 10^3 \pm 5.7$ cfu/g respectively and the Psychrophillic bacteria decreased significantly to $1.5 \times 10^4 \pm 5.7$, $1.1 \times 10^3 \pm 6.6$ cfu/g respectively in addition to 1% Mint oil the total yeast and mould decreased significantly reached to 5 ± 2.8 cfu/g and using 2% Mint oil completely inhibited the total yeast and mould.

During cold storage, the total viable count for fish samples treated with 1% and 2% Mint oil increased significantly and reached to $3.6 \times 10^7 \pm 5.7$ and $1.7 \times 10^7 \pm 1.1$ cfu/g respectively at the end of cold storage (10 days) respectively. The same trend was obtained for in Psychrophillic bacteria, which increased significantly for treated samples with 1% and 2% Mint oil reached to $3.7 \times 10^7 \pm 1.7$ and $1.8 \times 10^6 \pm 1.1$ cfu/g respectively at the end of cold storage after 10 days respectively. Moreover, the total yeast and mould count for fish samples treated with 1% Mint oil solution after 10 days increased to be 15 ± 2.8 cfu/g compared with 5 ± 2.8 cfu/g for zero time while it was undetected after dipping in 2% Mint oil and throughout cold storage period for fish samples treated with 2% Mint oil.

Table (13) Effect of Mint oil on the total viable bacterial count , psychrophillic bacteria and total yeast and mould (cfu/g) of *O.niloticus*_flesh during cold storage4˚C±1:

Storage period (Days)	Total viable bacterial count			Psychrophillic bacteria			Total yeast and mould		
	control	Mint oil 1%	Mint oil 2%	control	Mint oil 1%	Mint oil 2%	control	Mint oil 1 %	Mint oil 2%
Zero time	$2.7x10^{4}$ $\pm 2.3x10^{3}$ Aa	$1.3\ x10^{4}$ $\pm 1.1^{Ba}$	$1.1\ x10^{3}$ $\pm 5.7^{Ca}$	$2.2x10^{4}$ $\pm 1.1x10^{3}$ Aa	$1.5\ x10^{4}$ $\pm 5.7^{Ba}$	$1.1\ x10^{3}$ $\pm 6.6^{Ca}$	1.0x10 $\pm 0.00^{Aa}$	0.5x10 $\pm 2.8^{Ba}$	ND $\pm 0.00^{Ba}$
3	$7.2\ x10^{6}$ $\pm 1.4\ x10^{5}$ Ab	$2.9\ x10^{6}$ $\pm 1.1^{Ba}$	$4.5\ x10^{4}$ $\pm 2.3^{Ca}$	$2.8x10^{6}$ $\pm 2.3\ x10^{5}$ Ab	$1.9\ x10^{6}$ $\pm 5.7^{Ba}$	$2.3\ x10^{4}$ $\pm 5.7^{Ca}$	1.5x10 $\pm 2.8^{Aa}$	1x10 $\pm 0.00^{Aab}$	ND $\pm 0.00^{Bb}$
6	$2.2\ x10^{7}$ $\pm 1.7\ x10^{6}$ Ac	$9.2x10^{6}$ $\pm 1.7^{Ab}$	$2.3\ x10^{6}$ $\pm 1.7^{Bb}$	$3.3x10^{7}$ $\pm 5.7\ x10^{6}$ Ac	$8.9\ x10^{6}$ $\pm 1.7^{Bb}$	$3.2\ x10^{5}$ $\pm 1.1^{Cb}$	3.0x10 $\pm 5.7^{Aa}$	1x10 $\pm 0.00^{Bab}$	ND ±0.00Bc
10	®	$3.6\ x10^{7}$ $\pm 5.7^{*c}$	$1.7\ x10^{7}$ $\pm 1.1^{*c}$	®	$3.7\ x10^{7}$ $\pm 1.7^{*c}$ ®	$1.8\ x10^{6}$ $\pm 1.1^{*c}$	®	1.5X10 $\pm 2.8^{*b}$	ND $\pm 0.00^{*d}$

ND Not detected ® Rejected

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing→ a-d increasing ↑ * significant

Fig.(21): Effect of Mint oil on the total viable bacterial count, of *O. niloticus* flesh during cold storage at 4° C±1:

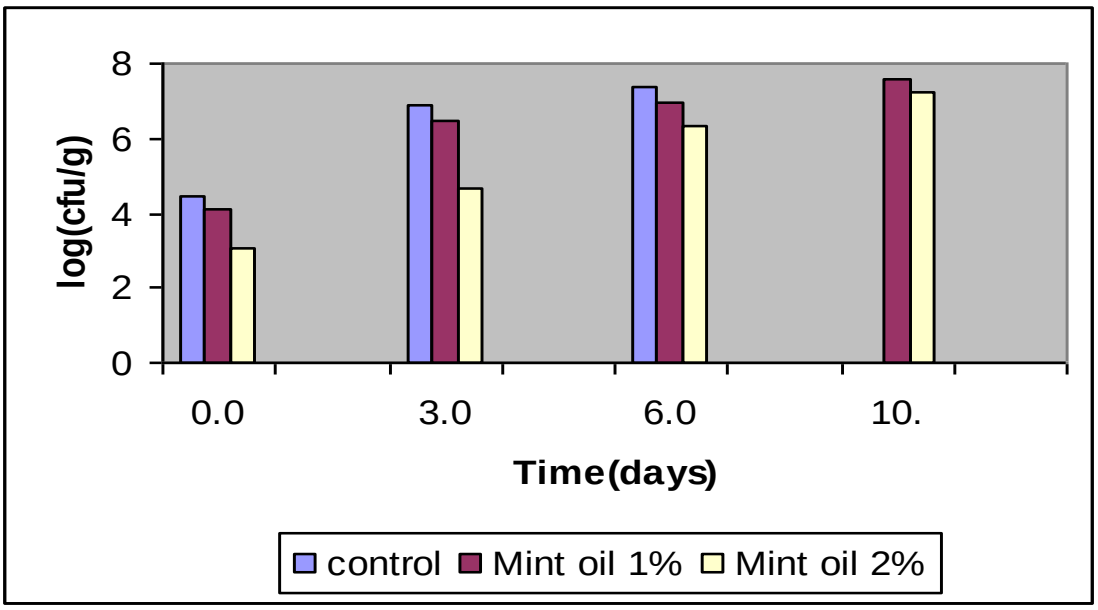


Fig.(22): Effect of Mint oil on Psychrophillic bacterial count of *O. niloticus* flesh during cold storage 4° C±1:

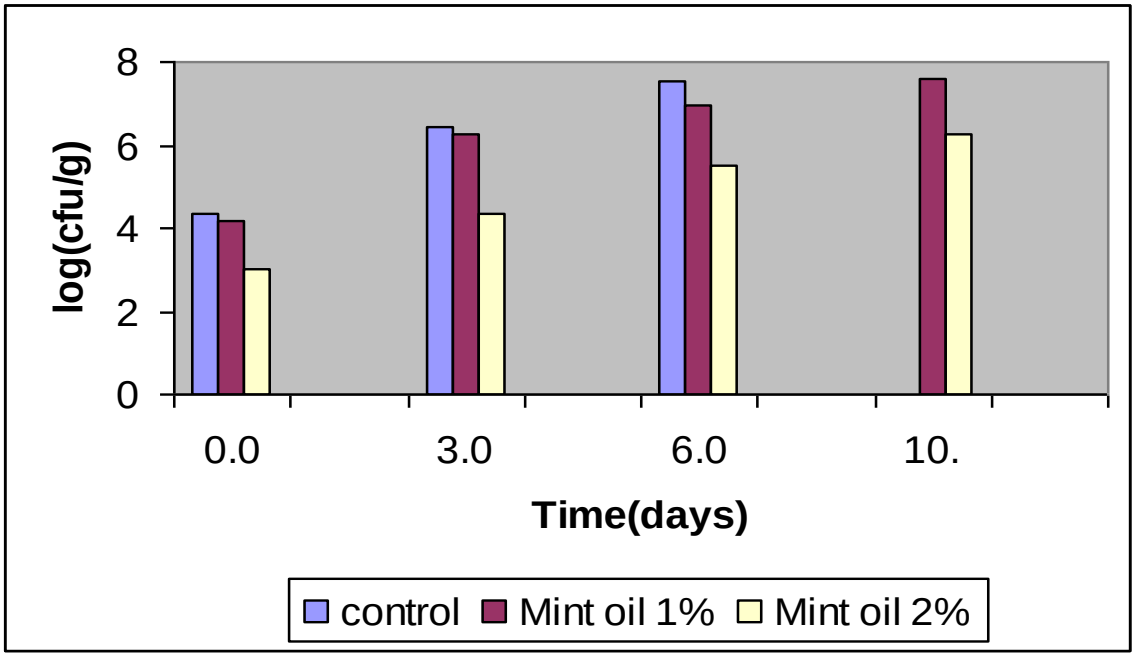
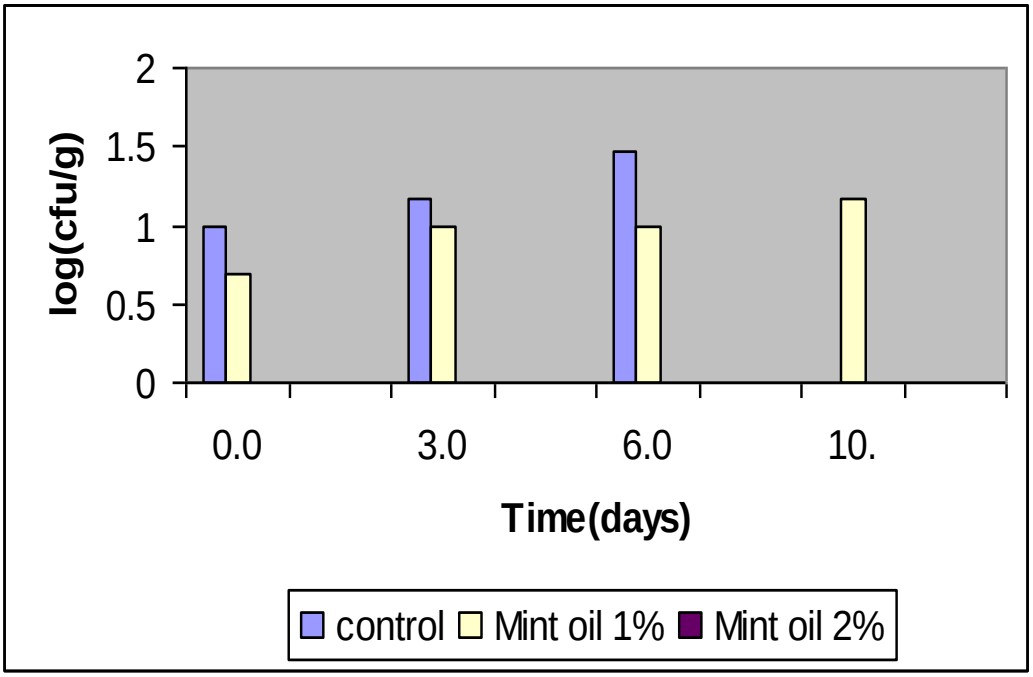


Fig.(23): Effect of Mint oil on total yeast and mould of *O. niloticus* flesh during cold storage 4° C±1:



5. 2.Effect of Mint oil on Enterococci, Staphylococci and *Bacillus cereus* counts of *O. niloticus* flesh during cold storage:

Data presented in table (14) and fig (24, 25, 26) showed the count of Enterococci, Staphylococci , and *Bacillus cereus* of fish samples as affected by dipping in Mint oil. The intial Enterococci count of control fish samples was $4.8 \times 10^2 \pm 34$ cfu/g then decreased significantly after dipping in 1 and 2% Mint oil solution reached to $3.2 \times 10^2 \pm 5.7$ and $1.5 \times 10^2 \pm 11$ cfu/g respectively and the intial of Staphylococci count of control fish was $5.6 \times 10^2 \pm 5.7$ cfu/g then decreased significantly after dipping in 1 and 2% Mint oil solution to $4.8 \times 10^2 \pm 17$, 20 ± 2.8 cfu/g respectively and the same in the intial count of *Bacillus cereus* of control fish was $3.8 \times 10^2 \pm 23$ cfu/g then decreased after dipping in 1 and 2% Mint oil solution to $1.5 \times 10^2 \pm 23$ and 45 ± 1.7 respectively.

During cold storage, the count of Enterococci for treated fish samples with 1 and 2% Mint oil solution increased gradually significant from $3.2 \times 10^2 \pm 5.7$ and $1.5 \times 10^2 \pm 11$ cfu/g respectively at zero time and reached to $5.6 \times 10^6 \pm 5.7 \times 10^4$, $1.1 \times 10^5 \pm 5.8 \times 10^3$ cfu/g respectively at the end of cold storage period (10 days) and The count of Staphylococci which affected by dipping in 1% and 2% Mint oil solution increased significantly from $4.8 \times 10^2 \pm 17$ and, 20 ± 2.8 cfu/g respectively at zero time and reached to $5.4 \times 10^4 \pm 1.4 \times 10^3$ and $9.7 \times 10^3 \pm 1.2 \times 10^2$ cfu/g respectively at the end of storage (10 days). In addition the count of *Bacillus cereus* for fish samples treated with 1% and 2% Mint oil solution increased significantly during the cold storage from $1.5 \times 10^2 \pm 23$ and 45 ± 1.7 cfu/g respectively at zero time and reached to $1.6 \times 10^5 \pm 5.8 \times 10^3$ and $1.1 \times 10^4 \pm 1 \times 10^3$ cfu/g respectively at the end of storage (10 days).

Table (14) Effect of Mint oil on the Enterococci, Staphylococci and *Bacillus cereus* (cfu/g) count of *O.niloticus* flesh during cold storage at 4˚C±1:

Storage period (Days)	Enterococci			Staphylococci			*Bacillus cereus*		
	control	Mint oil 1%	Mint oil 2%	control	Mint oil 1%	Mint oil2%	control	Mint oil 1%	Mint oil 2%
Zero time	$4.8 \times 10^{2} \pm 3.4 \times 10^{Aa}$	$3.2 \times 10^{2} \pm 5.7^{Ba}$	$1.5 \times 10^{2} \pm 1.1 \times 10^{Ca}$	$5.6 \times 10^{2} \pm 5.7^{Aa}$	$4.8 \times 10^{2} \pm 1.7 \times 10^{Ba}$	$2 \times 10 \pm 2.8^{Ca}$	$3.8 \times 10^{2} \pm 2.3 \times 10^{Aa}$	$1.5 \times 10^{2} \pm 2.3 \times 10^{Ba}$	$4.5 \times 10 \pm 1.7^{Ca}$
3	$4 \times 10^{4} \pm 1.1 \times 10^{3\ A\ a}$	$1.6 \times 10^{3} \pm 3.3 \times 10^{Ba}$	$6.5 \times 10^{2} \pm 1.7 \times 10^{Ca}$	$4.3 \times 10^{3} \pm 4 \times 10^{2\ Ab}$	$8.2 \times 10^{2} \pm 5.7^{Ba}$	$4 \times 10 \pm 1.2^{Ca}$	$1.1 \times 10^{4} \pm 5.7 \times 10^{2\ Aa}$	$7.1 \times 10^{3} \pm 8.8 \times 10^{Ba}$	$3 \times 10^{2} \pm 5.7^{Ca}$
6	$1.6 \times 10 \pm 1.1 \times 10^{5\ Ab}$	$2.2 \times 10^{5} \pm 1.1 \times 10^{4\ Bb}$	$2.1 \times 10^{4} \pm 5.7 \times 10^{2\ Cb}$	$1.2 \times 10^{4} \pm 1.1 \times 10^{3\ Ac}$	$8.8 \times 10^{3} \pm 2.3 \times 10^{2\ Bb}$	$6.6 \times 10^{2} \pm 5.8^{Cb}$	$3.5 \times 10^{5} \pm 1.1 \times 10^{4\ Ab}$	$8.7 \times 10^{4} \pm 1.1 \times 10^{3\ Bb}$	$7.9 \times 10^{3} \pm 2.9 \times 10^{2\ Cb}$
10	®	$5.6 \times 10^{6} \pm 5.7 \times 10^{4\ *}c$	$1.1 \times 10^{5} \pm 5.8 \times 10^{3\ *c}$	®	$5.4 \times 10^{4} \pm 1.4 \times 10^{3\ *c}$	$9.7 \times 10^{3} \pm 1.2 \times 10^{2\ *c}$	®	$1.6 \times 10^{5} \pm 5.8 \times 10^{3\ *c}$	$1.1 \times 10^{4} \pm 1 \times 10^{3\ *c}$

ND Not detected ® **Rejected**

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing→ a-c increasing ↑ * significant

Fig.(24): Effect of Mint oil on Enterococci count of *O. niloticus* flesh during cold storage 4̊ C±1:

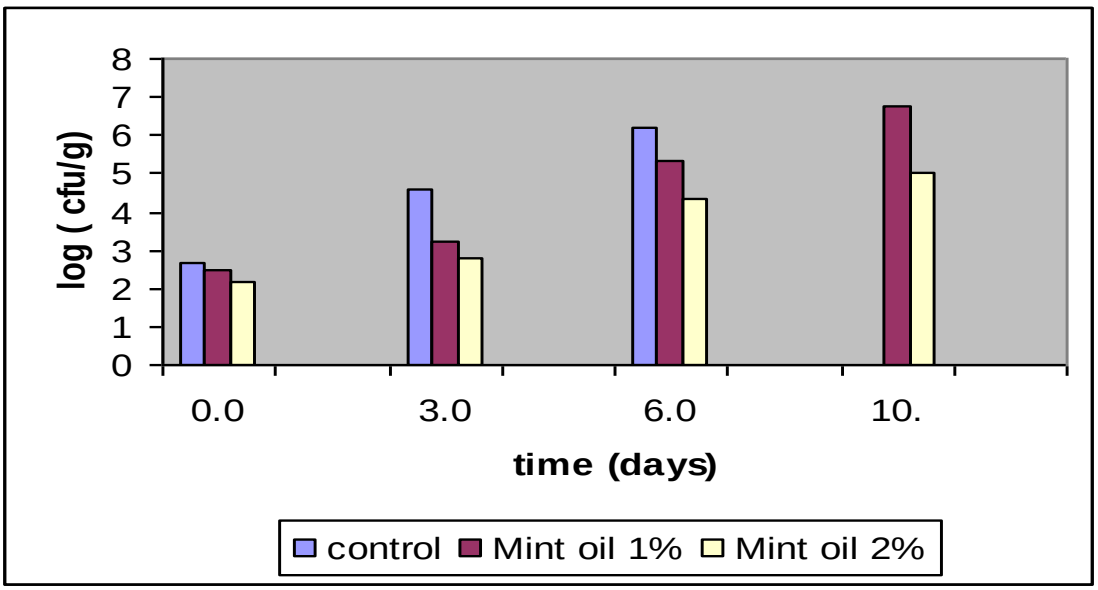


Fig.(25): Effect of Mint oil on Staphylococci count of *O. niloticus* flesh during cold storage 4̊ C±1:

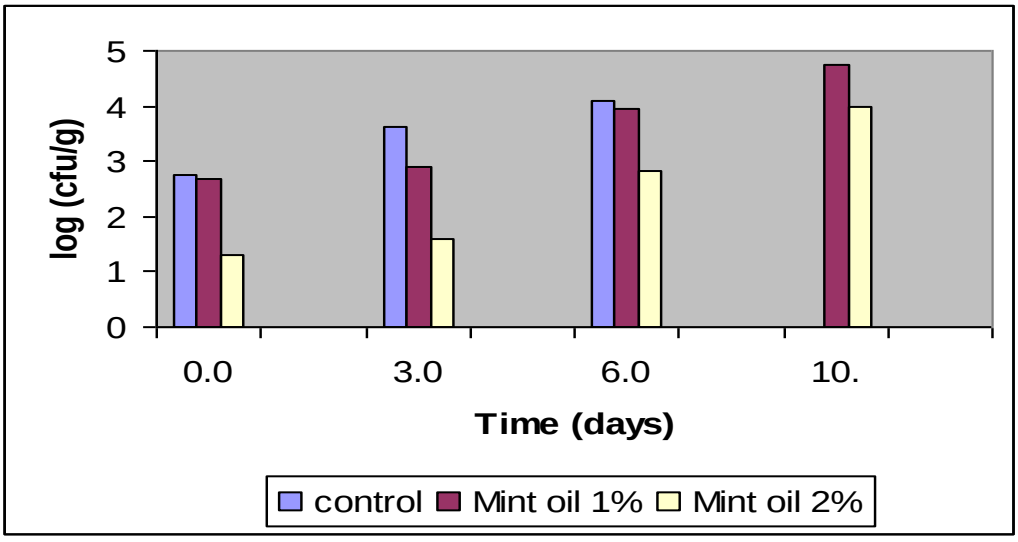
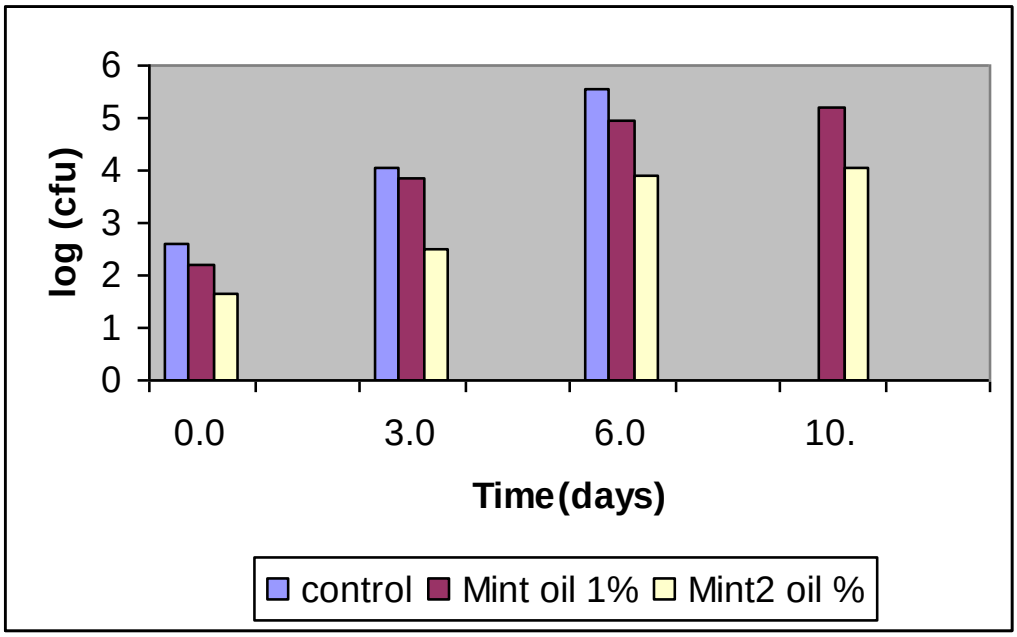


Fig.(26): Effect of Mint oil on *Bacillus cereus* count of *O. niloticus* flesh during cold storage 4° C±1:



5.3. Effect of Mint oil on the chemical properties of *O. niloticus* flesh during cold storage at 4°C±1:

Data in table (15) and fig (27) showed that the moisture content of the control samples was 81.98 ±0.01% at zero time and the moisture content of fish samples treated with 1% and 2% Mint oil solution were 81.54% ±1.00 and 81.31% ±0.01 respectively. The moisture content of control and fish samples immersed in 1% and 2% Mint oil solution significantly decreased during cold storage at zero time reached to 76.70% ±0.02, 76.49% ±0.00 and 76.70% ±0.01 respectively .

The effect of Mint oil on pH value was presented in table (15) and fig (28) in which pH value of the control sample was 6.45 ±0.01 at zero time while that treated samples with 1% and 2% Mint oil were 6.54 ±0.00 and 6.48 ±0.00 at zero time respectively. During the cold storage period the pH value were increased significantly reached to 6.97 ±0.00, 7.20 ±0.00 and 6.99 ±0.00 at the end of the storage period.

Table (15) Effect of Mint oil on the moisture content% and pH of *Oreochromis niloticus* flesh during cold storage at 4˚C±1

Storage period (Days)	**Moisture content%**			**pH**		
	control	Mint oil 1%	Mint oil 2%	control	Mint oil 1%	Mint oil 2%
zero time	81.98 ±0.01^{Ac}	82.54 ±1.00^{Ac}	81.31 ±0.01^{Ad}	6.54 ±0.01^{Aa}	6.54 ±0.00^{Aa}	6.48 ±0.00^{Bd}
3	79.57 ±0.02^{Bb}	78.64 ±0.02^{Cb}	79.97 ±0.01^{Ac}	6.71 ±0.00^{Ab}	6.66 ±0.01^{Bb}	6.55 ±0.01^{Cc}
6	76.70 ±0.02^{Ca}	76.78 ±0.01^{Ba}	77.66 ±0.00^{Ab}	6.97 ±0.00^{Ac}	6.78 ±0.00^{Bc}	6.71 ±0.00^{Cb}
10	®	76.49 ±0.00^{*a}	76.70 ±0.01^{*a}	®	7.20 ±0.00^{*d}	6.99 ±0.00^{*a}®

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing→ a-d increasing ↑ * significant ® Rejected

Fig.(27): Effect of Mint oil on moisture content of *O. niloticus* flesh during cold storage 4° C±1:

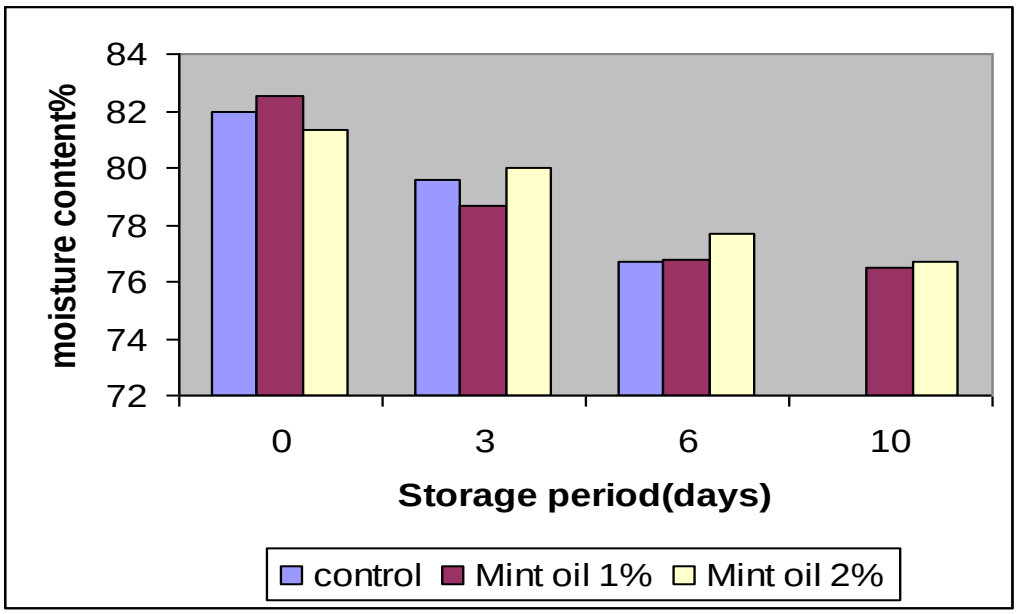
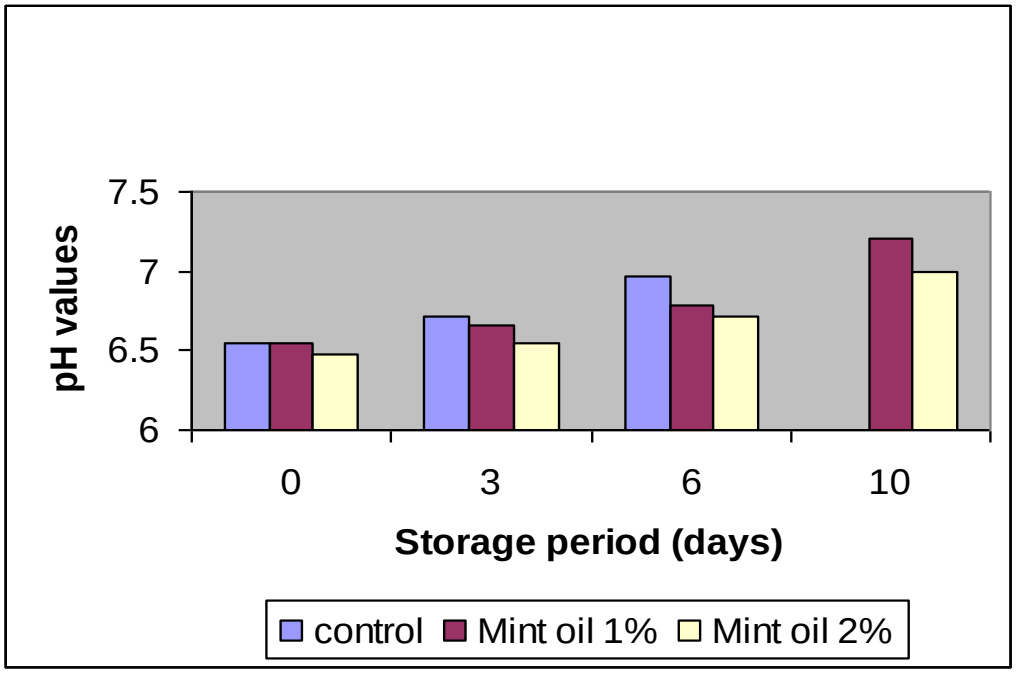


Fig.(28): Effect of Mint oil on pH value of *O. niloticus* flesh during cold storage 4° C±1:



Data in table (16) and fig (29) indicated also the TVBN of the control fish samples was 8.48 ±0.21 mgN/100g compared with the TVBN of fish samples treated with 1% and 2% Mint oil solution which decreased immediately and reached to 8.25 ±0.06 and 7.57 ±0.04 mg.N/100g respectively. During cold storage, the amount of TVBN increased significantly in all samples which the TVBN of control samples and that affected with 1% and 2% Mint oil solution reached 26.77 ±0.51 , 28.84 ±0.00 and 23.10 ±0.13 mg.N/100g respectively after 6, 10 and 10 days of cold storage period.

Data in table (16) and fig (30) showed that TBA value of control fish samples was 0.014 ±0.00 O.D at zero time of storage period, in addition, dipping on 1% and 2% Mint oil didn't affect this value at zero time. The TBA also followed during storage, in the control fish samples , 1% and 2% Mint oil treatment which it increased gradually during cold storage and reached 0.120 ±0.00 , 0.119 ±0.00 and 0.113 ±0.00 OD after 6, 10 and 10 days of cold storage respectively.

Table (16) Effect of Mint oil on TVBN (mg.N/100g) and TBA (ODλ_{max}538) of *O. niloticus* flesh during cold storage at 4˚C±1:

Storage period (Days)	TVBN			TBA		
	control	Mint oil 1%	Mint oil 2%	control	Mint oil 1%	Mint oil 2%
Zero time	8.48 ±0.21^{Aa}	8.25 ±0.06^{Aa}	7.57 ±0.04^{Ba}	0.014 ±0.00^{Aa}	0.014 ±0.00^{Aa}	0.014 ±0.00^{Aa}
3	18.42 ±0.23^{Ab}	11.25 ±0.03^{Bb}	8.60 ±0.17^{Cb}	0.042 ±0.00^{Ab}	0.047 ±0.00^{Bb}	0.042 ±0.00^{Bb}
6	26.77 ±0.51^{Ac}	20.15 ±0.09^{Bc}	12.30 ±0.17^{Cc}	0.120 ±0.00^{Ac}	0.070 ±0.00Bc	0.075 ±0.00^{Cc}
10		28.84 ±0.00^{*d}	23.10 ±0.13^{*d}	®	0.119 ±0.00^{*d}	0.113 ±0.00^{*d}

Means carrying different superscripts are significant at ($p \leq 0.05$)

A-C increasing→ a-d increasing ↑ * significant ® Rejected

Fig.(29): Effect of Mint oil on TVBN (mg.N/100g) of *O. niloticus* flesh during cold storage 4° C±1:

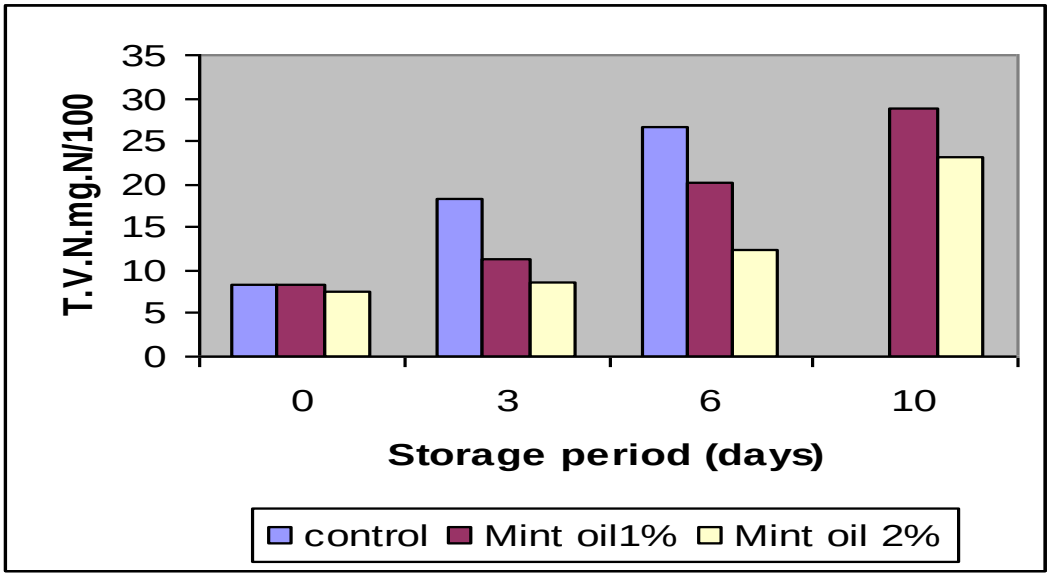
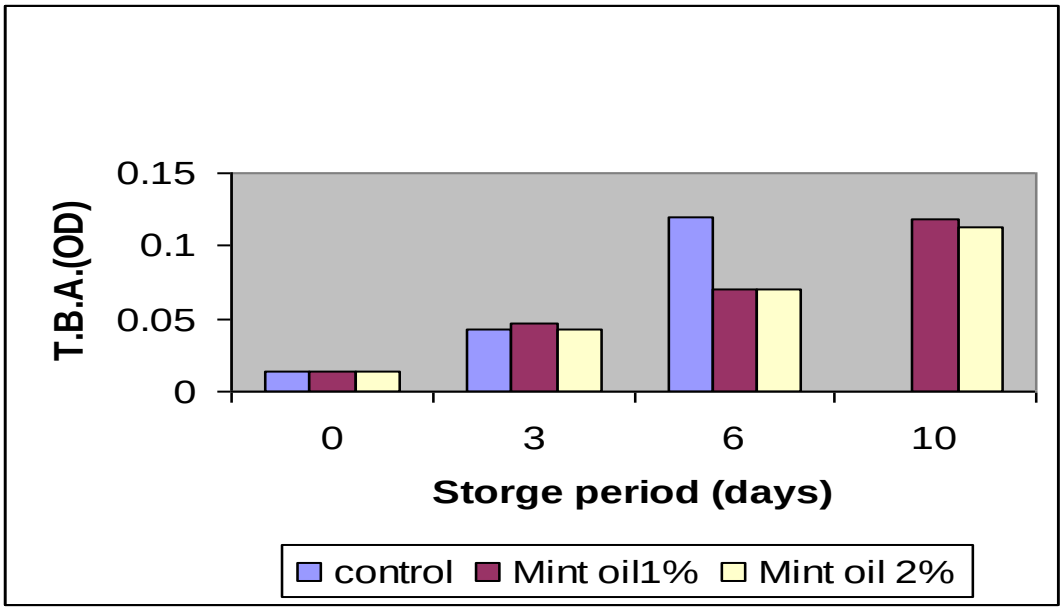


Fig.(30): Effect of Mint oil on TBA (ODλ_{max}538) of *O. niloticus* flesh during cold storage 4° C±1:



6-Organoleptic evaluation of *O. niloticus* flesh as affected by gamma irradiation with 1 and 3 kGy; K sorbate 1 and 2% and mint oil 1 and 2%:

Tilapia fish fillets samples were submitted to panelists immediately after the treatments and periodically during cold storage at 4 ±1 ºC to evaluate the changes in the organoleptic properties i.e. appearance, texture, odor and the overall acceptability. The degrees of the panelists are recorded in Table (17). The results of this table showed that the over all acceptability at zero time were 98.60 ±0.19; 96.30 ±0.59; 95.30 ±0.19 ;98.30 ±0.18; 98.0 ±0.57; 94.60 ±0.76 and 93.0 ±0.66% for control; irradiated fillets with 1 kGy; irradiated fillets with 2kGy; fillets immersed in 1% k-sorbate; fillets immersed in 2% k-sorbate; fillets immersed in 1% mint oil and fillets immersed in 2% mint oil, respectively. Regarding to mint oil treatment it was obvious that the overall acceptability for samples immersed in 2% mint oil at zero time was the lowest among the treatments. During cold storage period it could be noticed that there was a significant decrement in the appearance; odor; texture and overall acceptability for all the treatments under investigation as the storage period increase which reached to 39.60 ±0.18% for control fish sample at 6^{th} day of cold storage period where it was completely rejected by the panelists, and reached to 42.30 ±0.96 and 41.30 ±8.2% for fillets irradiated with 1 and 3 kGy at 26^{th} and 30^{th} day of cold storage period respectively at this time it were rejected by the panelists. The same decrement trend as the storage period increment was also observed in samples immersed in (k-sorbate 1 and 2%) and samples immersed in (1 and 2 % mint oil) which reached to (39.60 ±0.38 and 39.60 ±1.1) and (38.30 ±0.19 and 43 ±0.96 %) at 10^{th}; 14^{th}; 10^{th} and 10^{th} day of cold storage period, respectively which were rejected by the panelists at these times.

Table (17) Organoleptic evaluation of *O. niloticus* flesh as affected by gamma irradiation with 1 and 3 kGy; K sorbate 1 and 2% and mint oil 1 and 2% during cold storage at 4 ± °C

treatment			storage period (days)									
			0	3	6	10	14	18	20	22	26	30
control		appearance	9.8 ±0.002[a]	6 ±0.005[b]	3.8 ±0.007[c]							
		odor	9.9 ±0.003[a]	5 ±0.028[b]	3.7 ±0.005[c]							
		texture	9.9 ±0.00[a]	5.9 ±0.008[b]	4.4 ±0.11[c]							
		over all acceptable	98.60% ±0.19[a]	56.30% ±0.86[b]	39.60% ±0.18[c]							
gamma irradiation	1 kGy	appearance	9.7 ±0.005[a]	9.7 ±0.002[a]	9.6 ±0.005[a]	9.1 ±0.005[b]	8.2 ±0.11[c]	8 ±0.002[c]	7.3 ±0.17[d]	5.4 ±0.006[e]	4.3 ±0.17[f]	
		odor	9.6 ±0.11[ab]	9.5 ±0.12[ab]	9.5 ±0.005[ab]	9.1 ±0.006[ab]	8.1 ±0.2[a]	7.6 ±0.1[ab]	7.1 ±0.17[ab]	5.2 ±0.11[ab]	4.2 ±0.05[a]	
		texture	9.6 ±0.005[a]	9.5 ±0.12[a]	9.5 ±0.006[a]	9 ±0.05[b]	8.3 ±0.008[c]	7.9 ±0.005[d]	7.1 ±0.13[e]	5.2 ±0.11[f]	4.2 ±0.05[g]	
		over all acceptable	96.30% ±0.59[a]	95.60% ±0.67[ab]	95.30% ±0.33[ab]	90.60% ±0.57[ab]	82% ±0.16[b]	78.30% ±0.48[bc]	71.60% ±0.19[c]	52.60% ±0.19[de]	42.30% ±0.96[e]	
	2 kGy	appearance	9.6 ±0.05[a]	9.5 ±0.8[a]	9.5 ±0.005[a]	9.2 ±0.11[a]	8.9 ±0.11[a]	8.1 ±0.05[a]	7.6 ±0.12[a]	6.1 ±0.05[a]	5.2 ±0.11[a]	4.1 ±0.001[a]
		odor	9.5 ±0.009[a]	9.3 ±0.9[b]	9 ±0.1[ab]	8.7 ±0.005[ab]	8.3 ±0.005[ab]	7.8 ±0.05[b]	7.4 ±0.1[bc]	6 ±0.7[cd]	5.1 ±0.12[de]	4 ±0.006[e]
		texture	9.5 ±0.009[a]	9.3 ±0.85[ab]	9 ±0.003[ab]	8.8 ±0.05[ab]	8.3 ±0.005[bc]	7.7 ±0.02[bc]	7.4 ±0.17[c]	6.1 ±0.05[d]	5.1 ±0.23[de]	4.2 ±0.03[e]
		over all acceptable	95.30% ±0.19[a]	93.60% ±0.38[a]	91.60% ±0.11[ab]	98% ±0.59[ab]	85% ±0.76[bc]	78.60% ±0.50[cd]	74.60% ±0.19[d]	60.60% ±0.76[e]	51.30% ±0.19[f]	41% ±8.2[g]
K.sorbate	1%	appearance	9.7 ±0.005[a]	8.3 ±0.17[b]	6.6 ±0.05[c]	4.9 ±0.05[d]						
		odor	9.9 ±0.01[a]	8.3 ±0.04[b]	6 ±0.00[c]	3.2 ±0.05[d]						

		texture	9.9 ±0.03[a]	8.4 ±0.05[b]	6.1 ±0.05[c]	3.8 ±0.11[d]						
		over all acceptable	98.30% ±0.18[a]	83.30% ±0.96[b]	62.30% ±0.38[c]	39.60% ±0.38[d]						
		appearance	9.6 ±0.07[a]	8.9 ±0.05[b]	7.5 ±0.15[c]	5 ±0.08[d]	4.6 ±0.11[e]					
		odor	9.9 ±0.01[a]	8.9 ±0.04[b]	7.1 ±0.03[c]	4.9 ±0.11[d]	3.4 ±0.33[e]					
		texture	9.9 ±0.08[a]	8.8 ±0.17[b]	7 ±0.05[c]	4.9 ±0.05[d]	3.9 ±0.11[e]					
	2%	over all acceptable	98% ±0.57[a]	88.60% ±0.96[b]	72% ±0.38[c]	49.30% ±0.44[d]	39.60% ±1.1[e]					
Mint oil		appearance	9.4 ±0.23[a]	6.1 ±0.0.05[b]	4 ±0.11[c]	3.8 ±0.004[c]						
		odor	9.3 ±0.05[a]	6 ±0.008[a]	4.3 ±0.12[b]	4.9 ±0.05[b]						
		texture	9.7 ±0.005[a]	5.8 ±0.11[b]	4 ±0.28[c]	3.8 ±0.05[c]						
	1%	over all acceptable	94.60% ±0.76[a]	63% ±0.86[b]	41% ±1.7[c]	38.30% ±0.19[c]						
		appearance	9.3 ±0.05[a]	9.3 ±0.11[a]	6.3 ±0.07[b]	4.1 ±0.004[c]						
		odor	9.2 ±0.11[a]	9.1 ±0.13[a]	6 ±0.17[b]	4.9 ±0.17[c]						
		texture	9.6 ±0.17[a]	9.3 ±0.05[a]	5.4 ±0.14[b]	4.1 ±0.008[c]						
	2%	over all acceptable	93% ±0.66[a]	92% ±0.00[a]	59% ±0.86[b]	43% ±0.96[c]						

Means carrying different superscripts are significant at ($p \leq 0.05$) a→g increased

7.Characterization and identification of isolated pathogenic bacteria:

This deals with the biological characteristics and taxonomic identification of the selected isolates. This was carried out basically according to the key of Bergy's Manual of Systemic Bacteriology (**Holt *et al.* 1986).**

1-Taxonomic identification of Enterococci, it was gram positive, cocci, arranged in pairs, short chains, non motile and grew at MacConkey agar media. it was pen headed colony, pink color, circular, entire, raised edges, glistening, convex and 0.2 mm in diameter. It grew anaerobically, catalase and oxidase were negative, the isolate fail to grow at 5˚C and 50˚C, while it grew at temperature range 10 - 45˚C, the isolate could not grow at NaCl 7% and 10% (w/v) while grew in the presence of NaCl 6.5% (w/v). It was able to hydrolysis esculin , arginine and VP test was positive. The isolate could not produce all of α- galactosidase, β- galactosidase and β-glucuronidase also indole reaction was negative, while it fermented all of ribose, D-mannitol, sorbitol, D-sucrose, D-lactose and trehalose but could not ferment L-arabinose. Gelatin liquefaction, casein hydrolysis and starch hydrolysis were negative; while citrate utilization was positive. On the basis of the recommended keys for the identification, following the scheme of identification and characterization of bacteria and in view of the comperative study of isolate Enterococci as shown in table (18) the strain could be identified as *Streptococcus faecalis*.

2-Taxonomic identification of Staphylococci, it was gram-positive cocci, arranged in pairs and tetrads, graps like shape, non-motile, grew on *Staphylococcus* medium No.110. It was creamed coloued colonies, circular and raised. It grew anaerabically, catalase was positive but oxidase was negative. The isolate fail to grow at 5˚C and 10˚C and 50˚C, while it grew at temperature range 15˚C-45˚C, the isolate could not grow at NaCl 6.5% and 7% (w/v) while grew in the presence of NaCl 10% (w/v). It was not hydrolysis esculin but it reduced the nitrate. It was able to hydrolysis arginine and VP test were positive. The isolate could not produce α- galactosidase and β-glucuronidase while it produce β- galactosidase. Also indole reaction was negative while it fermented all of D-ribose,D- mannitol,D- sucrose,D- lactose,

trehalose, maltose,D- galactose and D-fructose but could not fermented arabinose, sorbitol and glucose. Gelatin liquefaction, casein hydrolysis, starch hydrolysis and citrate utilization were negative. On the basis of the recommended keys for the identification, following the scheme of identification and characterization of bacteria and in view of the comperative study of isolate Staphylococci as shown in table (18) the strain could be identified as *Staphylococcus aureus*.

3- Taxonomic identification of *Bacillus cereus*, it was gram-positive bacilli, occurred in chain, motile and it grew on *Bacillus cereus* media. It was yellow colored colony with dark center, circular, raised, opaque pen headed colony and convex. It grew anaerabically, catalase was positive but oxidase was negative. The isolate fail to grow at 5˚C, 10˚C, 15˚C, 45˚Cand 50˚C, while it grew at temperature range 30˚C - 40˚C, the isolate could not grow at NaCl 6.5% and 10 %(w/v) while grew in the presence of NaCl 7 %(w/v). It was not hydrolysis esculin, It was able to hydrolysis arginine and VP test were positive The isolate could not produce all of α-galactosidase, β- galactosidase and β-glucuronidase. In addition, indole reaction was negative, while it fermented all of sorbitole, D-sucrose, D-lactose, trehalose and D-glucose but could not fermented D-ribose, arabinose, D-mannitol, D-fructose, and maltose. Gelatin liquefaction, casein hydrolysis and starch hydrolysis were positive, while citrate utilization was negative. On the basis of the recommended keys for the identification, following the scheme of identification and characterization of bacteria and in the view of the comperative study of isolate *Bacillus cereus* as shown in table (18) the strain could be identified as *Bacillus cereus*.

Table (18) physical and biochemical characters of the isolated bacteria

Test	*Streptococcus faecalis*	*Staphylococcus aureus*	*Bacillus cereus*
Gram stain	+	+	+
Motility	-	-	+
Anaerobic growth	+	+	+
Catalase	-	+	+
Oxidase	-	-	-
Growth at :			
5 ^{o} C	-	-	-
10 ^{o} C	+	-	-
15 ^{o} C	+	+	-
30 ^{o} C	+	+	+
37 ^{o} C	+	+	+
40 ^{o} C	+	+	+
45 ^{o} C	+	+	-
50 ^{o} C	-	-	
Growth at NaCl:			
6.5%	+	-	-
7%	-	-	+
10%	-	+	-
O/F	+F	+F	+F
Nitrate reduction	-	+	+
Arigginine dihydrolase	+	+	+
Voges- proskauer	+	+	+
Production of:			
α- galactosidase	-	-	-
β- galactosidase	-	+	-
β- glucuronidase	-	-	-
Indole production	-	-	-

Table (18) physical and biochemical characters of the isolated bacteria

Test	*Streptococcus faecalis*	*Staphylococcus aureus*	*Bacillus cereus*
Acid production from :			
D-Ribose	+	+	-
Arabinose	-	-	-
D-Mannitol	+	+	-
Sorbitol	+	-	+
D-Sucrose	+	+	+
D-Lactose	+	+	+
Trehalose	+	+	+
D-Galactose	-	+	+
D-Glucose	-	-	+
D-Fructose	-	+	-
Maltose	-	+	-
Hydrolysis of Casein	-	-	+
Hydrolysis of Gelatin	-		+
Hydrolysis of Starch	-	-	+
Citrate utilization	+	-	-
Esculin hydrolysis	+	-	-

8. Identification of mould:

7.1.Macroscopic Features

Colonies of *Mucor* grow rapidly at 25-30°C and quickly cover the surface of the agar. Its fluffy appearance with a height of several cm resembles cotton candy. From the front, the color is white initially and becomes grayish brown in time. From the reverse, it is white. (fig.31)

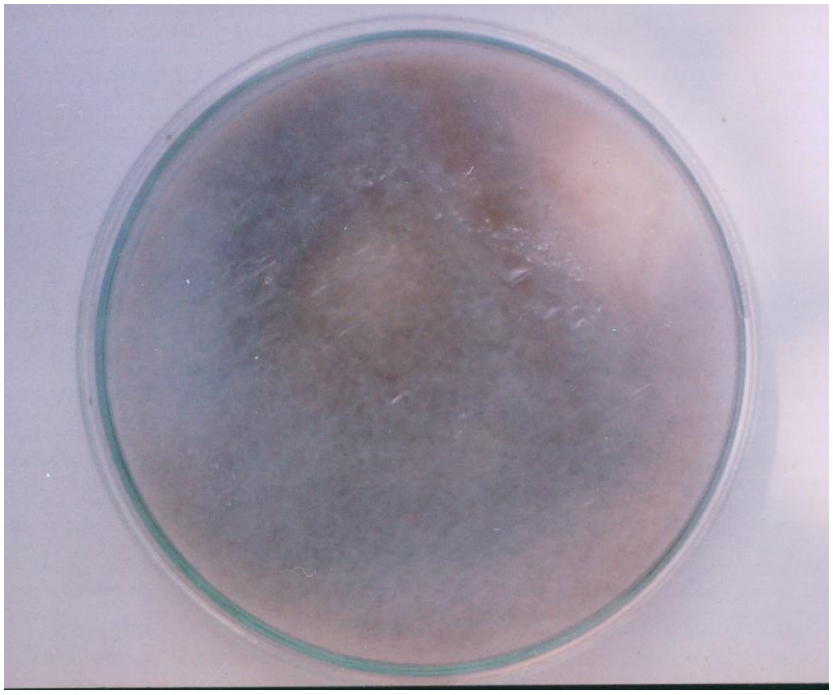


Fig.31 Macroscopic photograph of *Mucor* sp

7.2.Microscopic Features

Sparsely septate hyphae, sporangiophores, sporangia, and spores are visualized. Sporangiophores are short, Branched and hyaline. Sporangia are round, gray to black in color, and are filled with sporangiospores .sporangiospores are freely spread. A collarette may sometimes be left at the base of the sporangium following its rupture.The sporangiospores are round (fig 32)

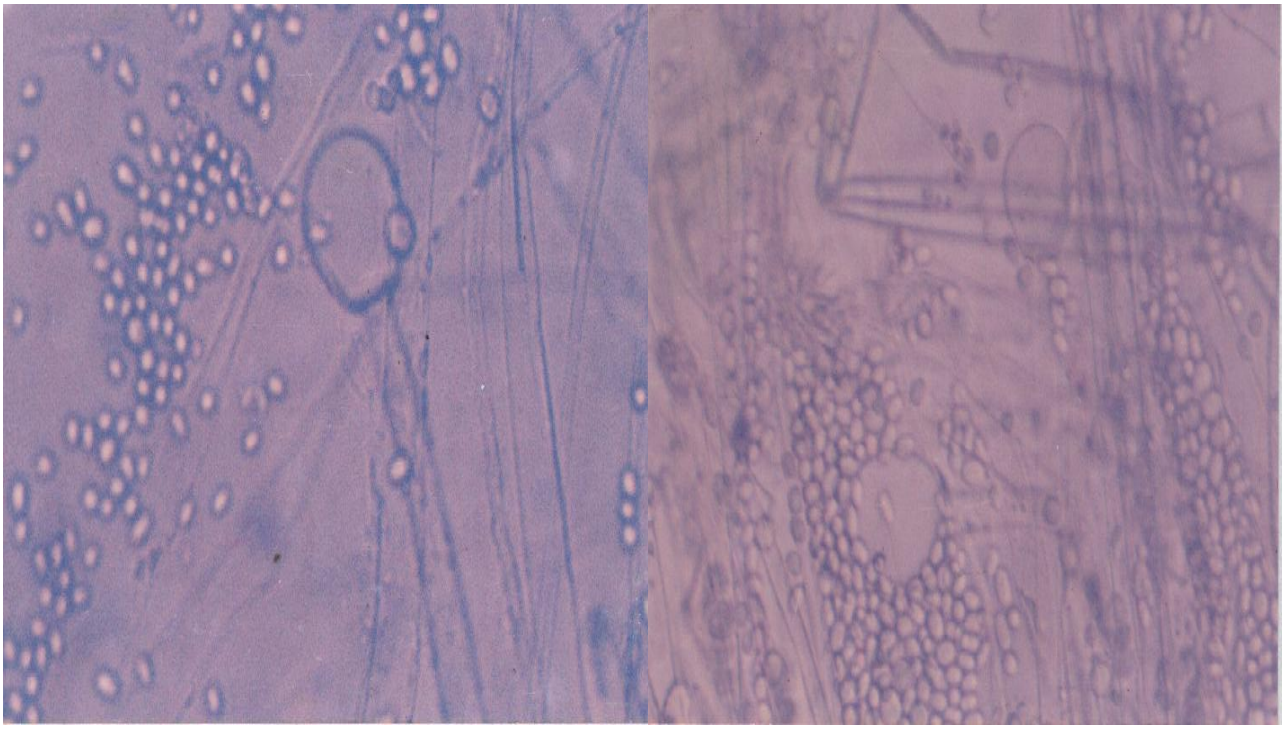


Fig.32 Microscopic photograph of *Mucor* sp