In the last few years, symptoms of soft rot on apple and pear fruits in different markets at Fayoum Governorate and El-Elbour market at Cairo Governorate were observed furthermore, aims of this study were to isolate, identify the causal agents of soft rot of apple and pear fruits, to study the host range and the response of different apple and pear to selected bacterial isolates and to study the effect of preharvest, postharvest and pre and postharvest treatments with bacteriocin like substance, Ethanolic extract of Propolis (EEP), some plant extracts, some mineral salts and antioxidants compounds as alternative to fungicides.

The research points and results of this study can be summarized as follows:

1. Screening, isolation and pathogenicity tests of soft rot isolates isolated from apple and pear 

- In this experiment, a loopful of the supernatant fluid of rotted apple and pear fruit tissue was streaked on potato dextrose agar (PDA) and nutrient agar (NA). A total of 67 of bacterial isolates were isolated. Out of them 40 isolates from apple fruits and 27 isolates from pear fruits.

2. Host range of selected soft rot virulent isolates

- In this experiment, different vegetables and fruits were infected by the selected soft rot isolates using hole and puncturing techniques. This experiment revealed that all selected isolates could macerate all fruits and vegetables tested such as apricot, peach, cucumber, pepper, tomato, potato, bean, okra, carrot and squash, of garlic and onion. The highest severity of disease was recorded for Apricot, Peach, Tomato, cucumber, followed by Squash, Pepper, bean, Okra, Carrot and Potato, while the lowest maceration was recorded for Garlic. 

3. Response of various apple and pear varieties to the selected soft rot isolates.

- In this experiment some apple and pear fruits were infected by most virulent soft rot isolates using hole technique and incubated at 28°C for 5 days. Also, It was noticed that Anna apple fruits were the most susceptible to Bacillus soft rot infection (57.06%) followed by Granny smith (31.28%), Red Chief (27.39%) and Fuji (25.95%) soft rot severity. A moderate reaction to Bacillus soft rot strains infection was recorded when fruits of apple Royal gala (20.50% soft rot severity) were inoculated. Le-Conte pear fruits were the most susceptible to Bacillus soft rot infection (76.03%) followed by Bosc pear (18.23%), while Yellow Bartlett pear was the lowest susceptible to Bacillus soft rot infection (12.94%) soft rot severity.

4. Phenotypic and genotypic taxonomic studies of selected soft rot isolates and related strains.

- In this part, the most virulent isolates (AB4, AB6 and PB6) were phenotypically and genotypically identified. 

- The results of phenotypic characterizations showed that strain AB4 and AB6 were similar to Bacillus altitudinis41KF2b, while strain PB6 was similar to B. pumilus SAFR-032. 

- Phylogenetic analysis based on 16S rDNA gene sequences indicated that strains AB4, AB6 and PB6 are very similar to one another (99% sequence homology) and show homology 99% with Bacillus altitudinis41KF2b; Bacillus aerophilus strain 28k, Bacillus stratosphericus 41KF2a and Bacillus pumilus SAFR-032. Strain AB4 and Strain AB6 are closely related to one another and are cluster with a common identified Bacillus altitudinis 41KF2b strain, and were therefore tentatively assigned to this species. While strain PB6 appear slightly closer to B. pumilus SAFR-032 than to Bacillus altitudinis41KF2b based on 16S rDNA gene therefore tentatively assigned to this species. 

5. Antibacterial activity of bacteriocin-like substance from lactic acid bacteria against soft rot Bacillus strains

- In this experiment, antibacterial activity of partially purified bacteriocin-like substance from eight lactic acid bacteria against soft rot Bacillus strains were evaluated using clear zone technique. The results showed that all soft rot Bacillus strains were significantly inhibited by all different bacteriocin produced from lactic acid bacterial strains used in this study. The highest antibacterial activity against Bacillus soft rot strains was recorded for Lab2, Lab105 and
Lab107, which exhibit clear zone diameter 29.61, 27.50 and 25.89 mm, respectively. While, bacteriocin from strain L100, L11 and L13 exhibit clear zone diameter 23.72, 20.89 and 19.56 mm, respectively. Therefore, bacteriocin from strains of Lab2, Lab105 and Lab107 were used as alternative natural antibacterial products to control soft rot disease under field conditions 6.

Antibacterial activity Ethanol extract of Propolis against soft rot Bacillus strains
- Antibacterial activity of different propolis extract concentrations were evaluated by agar well diffusion technique against soft rot Bacillus strains. The results showed that the highest inhibition zone (30.33 mm) was recorded for propolis at concentration of 10 mg/ml, while propolis at concentration of 2.5 mg/ml showed slight inhibition zone (17.28 mm) against Bacillus strains. The most sensitive soft rot Bacillus strains was for AB6 strain, followed by PB5, PB6, AB5, PB1, AB4.

7. Antibacterial activity of some plant extracts against soft rot Bacillus strains
- In this experiment, antibacterial activity of nine plant extracts against the selected soft rot Bacillus strains were evaluated by clear zone technique. The results showed that the nine tested types of plant extracts exhibited various degrees of antibacterial activity against Bacillus soft rot strains, as indicated by inhibition zone diameters. All crude plant extracts showed inhibition zones at 10 mg/ml against Bacillus strains. These data showed that Eucaalyptus globulus, Psidium guajava, Glycerhaiza glabra, Punica granatum and Cucurbita pepo were the most effective plant extracts against soft rot Bacillus strains, which were 24.33, 21.17, 20.72, 19.67 and 16.95 mm respectively, followed by Foeniculum vulgare, Citrus sinensis, Morus alba and Cuminum cyminum exhibit clear zone diameter 13.17, 11.45, 10.39 and 5.70 mm, respectively. Also, the data revealed that PB6 Bacillus strain was the most sensitive soft rot strain to all tested plant extracts, followed by PB5 Bacillus strain, while AB5 and AB6 Bacillus strains were the lowest sensitive soft Bacillus strains to all tested plant extracts.

8. In Vitro antibacterial activity of some mineral salts and antioxidant compounds against Bacillus soft rot strains isolated from apple and pear fruits.
- Antimicrobial activity of some mineral salts and antioxidant compounds was determined by agar well diffusion technique. The results showed the effect of different salt and anti-oxidants compounds on the production of clear zone of inhibition against Bacillus strains. Two concentrations of each of salts and antioxidants were evaluated under in vitro condition for their inhibitory effect against the soft rot Bacillus strains isolated from apple and pear fruits. Results indicate that compared to control, all treatments significantly reduced the growth of all Bacillus strains. The higher antibacterial activity of the salt and antioxidant compounds used in this study was 30.22, 29.17 and 28.61 mm for salicylic acid, cooper sulphate and ascorbic acid, respectively, followed by Benzoic acid, potassium sorbate and calcium chloride, which recorded the antibacterial activity, 25.94, 24.06 and 22.95 mm, respectively. Also, from these data, it was noticed that clear zone diameter increased as the concentrations of mineral salt compounds and antioxidants are increased, suggesting that these compounds have lethal or inhibition effect on bacterial cells.

9. Evaluation of bacteriocin like substance, Propolis, plant extracts and some mineral salts and antioxidants compounds as a pre, post and pre and postharvest for the control soft rot disease of apple and pear fruits in vivo
- Under natural and artificial infection all bacteriocin like substance from lactic acid bacteria treated apple and pear fruits showed significantly decreased on disease severity 207 than the untreated fruits. Bacteriocin produced from L2 strain was effective in reducing the disease severity.

- Pre- postharvest treatments with different bacteriocin like substance was most efficac treatment on the disease severity under naturally or artificially inoculated apple and pear fruits followed by pre then postharvest treatments.
- Ethanolic Extract of Propolis (EEP) at all tested concentrations reduced significantly the disease severity of either naturally infected or artificially inoculated apple and pear fruits with Bacillus altidinus (AB6) during seasons 2011 and 2012.
- Pre- postharvest treatments with different concentrations of (EEP) was most efficacy treatment on the disease severity under naturally or artificially inoculated apple and pear fruits followed by pre then postharvest treatments during 2011 and 2012 seasons.
- All tested plant extracts, G. glabra, P. guajava, E. chamadulonisis and P. granatum significantly reduced the soft rot disease (Table 2). The most effective treatments with plant extracts were E. golobous, followed by P. guajavain all time application of treatments. 208
- Pre- postharvest treatments with tested plant extracts were most efficacy treatment on the
10. Effect of preharvest spraying of bacteriocin like substance, Propolis, some plant extracts, some mineral salts and antioxidants compounds on some physical and some chemical properties of apple and pear fruits at harvest time and after cold storage for 60 days.
- the effect of preharvest spraying of bacteriocin like substance, Propolis, some plant extracts, some mineral salts and antioxidants compounds on some physical and chemical properties of apple and pear fruits treated with all treatments than those the untreated control. The apple and pear fruits firmness, TSS were the highest with bacteriocin produced from Lab2 strain while titratable acidity was the highest with Lab 105 strain at harvest time and after cold storage for 60 days.
- In bacteriocin like substance the total phenolic content was higher in apple and pear fruits treated with all treatments than those the untreated control. The apple and pear fruits firmness, TSS were the highest with bacteriocin produced from Lab2 strain while titratable acidity was the highest with Lab 105 strain at harvest time and after cold storage for 60 days.

Spray of apple and pear fruits with certain salts and antioxidants i.e. sodium bicarbonate, calcium chloride, potassium chloride, potassium sorbate, cooper sulphate, ascorbic acid, benzoic acid and salicylic acid could reduce significantly the disease severity of natural infection or artificial inoculation of fruits during 2011 and 2012 seasons

Ascorbic acid was the most effective treatment in decreasing apple and pear soft rot fruits. Ascorbic acid also was the most effective treatment in decreasing apple and pear fruits in natural infection and artificial infection followed by calcium chloride and salicylic acid. On the other hand the least effective salts were recorded in potassium chloride, sodium bicarbonate and benzoic acid in apple and pear. [209]

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- in case of Ethanolic extract of Propolis the The highest value in firmness was recorded in 7.5 mg/ml which were 6.03 Kg/cm2 followed by 10 mg/ ml which were 5.30 Kg/cm2 at harvest time while in pear the highest value was 6.20 Kg/cm2 in 10 mg/ml followed by 7.5 Kg/cm2 which recorded 6.03 Kg/cm2. By the end storage period the fruit 210 firmness values were 5.13 and 5.03 Kg/cm2 in 7.5 mg/ml and 10 mg/ml respectively, in pear fruits were 5.50 Kg/cm2 in 7.5 mg/ml followed by 5.40 in 10 mg/ml. Regarding TSS the highest value was 13.42 and 14 recorded in 10 mg/ml in apple and pear followed by 13.30 and 13.23 in 7.5 mg/ml in apple and pear respectively at harvest time while after 60 days TSS values were increased. The highest value was 14.23 and 14.60 in 10 mg/ml in apple and pear fruits. TTA and TPC values were decreased during storage time where the highest TTA and TTC values were 0.54 and 0.31 in 2.5 mg/ml and 1.36 and 1.36 mg ml-1 in 10 mg/ml in apple and pear fruits respectively, while after 60 days TTA and TPC were 0.25 and 0.19 in 10 mg/ml and 0.46 and 0.55 mg ml-1 in 2.5 mg/ml in apple and pear fruits respectively.

- Regarding the plant extracts the fruit firmness were 5.20 Kg/cm2 and 5.73Kg/cm2 for Eucalyptus golobous and Pisidium guajava compared with 4.30 Kg/cm2 and 5.30Kg/cm2 in control treatment, on apple and pear fruits respectively. Total soluble solids percentage was 12.07 to 13.00% and 13.50 to 14.00 % developed by treatments, in apple and pear fruits respectively comparing with 11.68% developed by control. The apple and pear fruits firmness values were increased from a low of about 0.33 and 0.44 mg ml-1 to 211 the end of the cold storage for 60 days in apple and pear fruits. Ascorbic acid also was the most effective treatment in decreasing apple and pear soft rot fruits. Ascorbic acid also was the most effective treatment in decreasing apple and pear fruits in natural infection and artificial infection followed by calcium chloride and salicylic acid. On the other hand the least effective salts were recorded in potassium chloride, sodium bicarbonate and benzoic acid in apple and pear. [210]

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respectively. The total soluble solids of apples fruit increased gradually with increasing the storage durations. The maximum total soluble solids (13.80%) and (15.80%) were recorded in apple and pear fruits stored for 60 days as compared to 11% and 12.17% observed in fresh harvested apple and pear fruits respectively. The titratable acidity was the highest (0.67 %) in ascorbic acid, followed by salicylic acid with 0.64 % in apple fruits while in pear fruits was (0.39%) in benzoic acid and copper sulphate. The difference in titratable acidity in these treatments was, however, non-significant but potassium sorbate had the least titratable acidity (0.30 % and 0.20) in apple and pear fruits respectively. The titratable acidity of apple and pear juice decreased significantly with increasing storage duration so that it was the highest (0.67 % and 0.42%) in fresh harvested fruits while the least (0.30 % and 0.20%) in fruits stored for 60 days. The maximum TSS/Acid ratio (45.16) recorded in sodium bicarbonate followed by calcium chloride with 43.12 in apple fruits while in pear fruits the maximum TSS/Acid ratio (74.65) in potassium sorbate followed by Calcium chloride with 67.78. The minimum TSS/Acid ratio (17.21) recorded in ascorbic acid, followed by benzoic acid with 18.33 in apple while in pear the minimum TSS/Acid ratio (29.69) recorded in ascorbic acid followed by cooper sulphate with 30.93. Storage duration had a significant effect on TSS/Acid ratio of apple and pear juice. Total fruit phenolic concentrations increased from a low of about 0.49 and 0.55 mg ml-1 at the beginning of the harvest season to about 1.05 and 1.17 mg ml-1 at the end of the cold storage for 60 days in apple and pear fruits respectively.