5. SUMMARY AND CONCLUSION

The frying process is the most popular assay in food preparation that totally depends on plant oils. our experiments were designed to investigate the potential effecting on frying times and potato form either pre-fried or raw potato on both selected oils included mixed oil and sunflower oil without antioxidants additives. In this context, this work had been divided into two main parts as follow:

Firstly: the frying experiment session was designed as: Zero session "the first, second and the third sessions", after 24 hrs "the fourth, fifth and the sixth sessions", after 48 hrs "the seventh, eighth, ninth, tenth, eleventh and twelves sessions". The time between every frying once was calculated and adjusted between 10 min for raw potatoes and 5 min for pre-fried potatoes. Also, both of mixed and sunflower oils were used for the aforementioned treatments. During the frying process, the random samples were collected in dark bottom and then ready to be analyzed. Moreover, samples from the first, sixth, eighth, ninth, eleventh and twelve sessions were selected for further analysis. Due to the sterols oxidation and oxidation byproducts in these samples were mentioned before as we find from the previous publications. Then, the physical parameters of the selected samples such as RI, SG and color were considered. Furthermore, the chemical features during the deep-frying process such as PV, AV, SV, IV and EV were also monitored.

Secondly: Accordingly, the oxidation characteristics for the chosen samples have to be measured. Thus, the *P*-AV, TBA, PC and TV were assayed and discussed. After that, the sterols oxidation derivatives were identified using the traditional and advanced methods. Therefore, the

sterols were detected before, during and after dee-frying technique using GC-MS.

The obtained results could be summarized in the following points:

1. The RI among oil was increased slowly to be from 1.4709 to 1.4732 at 40 °C except the kind of oil and potatoes. Equally, the significant difference (P<0.05) between the sunflowers that used for either raw or pre-fried potatoes frying was found. RI was high stability for the raw than pre-fried potatoes either mixed or sunflower oils.
2. As for the SG, the significant difference (P<0.05) between mixed and sunflower oils had been investigated especially for raw potatoes. In contrast, there is no difference (P>0.05) between them when used for pre-fried potato deep-frying treatment.
3. In the present experiments, the yellow glasses were fixed at a value of 35 and the variation in oil color was observed with the red glasses. However, they were increased dramatically during the deep-frying treatment with prolonged the periods. On the other hand, the sunflower was more stable than mixed oil; however, it was increased drastically to be 3.9 for both potatoes at the end of frying treatments.
4. PV sharply increased during the prolonged frying time reaching a maximum at the third day either mixed or sunflower oils for both potatoes. In opposition, there is no significant difference (P>0.05) between the raw and pre-fried potatoes after fried them using mixed oil; conversely, the significant difference (P<0.05) between raw and pre-fried potatoes after fried them by sunflower was perceived.
5. AV was steadily increased during the extending the frying periods regardless the kind of oils or potatoes except the first twice frying through the third day. Generally, the oils which had been used for raw potatoes have more steadiness than pre-fried potatoes.

6. SV suddenly decreased during the elongated frying time accomplishment a minimum at the third day either mixed or sunflower oils for both potatoes to be 195.05 and 112.81 mg KOH g^{-1} oil for the first and the last time, respectively. The deep-frying had effect on mixed oil deterioration than sunflower oil.
7. The highest and the lowest IV were found in sunflower oil after using it to pre-fried potatoes frying to be 129.7 and 72.82 g I_2 $100g^{-1}$ oil, respectively. That means that the IV was decreased slowly in the oil which used for raw potato frying than the others once.
8. EV was decreased significantly (P<0.05) with the extending frying treatments from 194.64 to 111.58 for the first and the last deep-frying time, respectively. Logically, the EV was decreased slowly in the oil which used for raw potato frying than the others once. Conversely, The EV was decreased radically for both oils that used for pre-fried potatoes frying than the others once.
9. Frequently, the highest and the lowest *P*-AV were noticed in the mixed and sunflower oil to be 4.0 and 74.0 absorbance at 530 nm, respectively. Sense that, the deep-frying influencing had peaked in sunflower oil especially for the pre-fried potatoes. Contrariwise, they inducing had bottomed on mixed oil either raw or pre-fried potatoes deep-frying treatments.
10. TBA values were gradually and significantly (P<0.05) increased by the increasing of frying process duration from 0.24 to 2.78 mg malonaldehyde Kg^{-1}, respectively. Also, there is a significant difference (P<0.05) was found between mixed and sunflower oils regardless the kind of potatoes. However, no significant difference (P>0.05) between pre-fried and raw potatoes either sunflower or mixed oils was observed.

11. PC of mixed and sunflower oils were significantly ($p<0.05$) different from each other. Then, the PC was significantly ($p<0.05$) and dramatically increased during the prolonged of the frying time from 0.00 to 1.72%, respectively.

12. TV were seen the pre-fried that fried by sunflower and raw potato after frying using mixed oils, respectively, thus indicating the highest and lowest stability of frying oil to oxidative rancidity. TV decreased in sunflower than mixed oils and this may be according the role of artificial antioxidants that have been added in it.

- The unsaponifiable matters of sunflower oil were heated at 180 ±5 °C for different frying session were analyzed by GC-MS .

The major peak was appeared at 22.78 min. which corresponded to β-sitosterol ,while the second one was relatively small and appeared at 17.19 which is equal to campesterol ,the third peak appeared at 17.67 min which is equal to stigmasterol .two other very small peak of sterols appeared almost after 23.75 min and 31.15 min . it seems that other sterols of sunflower oil (D5-avenasterol and D7-stigmastenol .

The predominant phytosterol in fresh oil without heating was β -sitosterol, comprising (70.80%) of total phytosterols determined, followed by campesterol(8.95%) , stigmasterol(7.58%), D5-avenasterol(5.95%) and D7-stigmastenol(4.74%) in sunflower oil .

Different small peaks began to appear in the sterol region, it seems that the sterol fraction of sunflower oil began to be oxidized at the First session of frying ,however. Such peaks started to be more clear at six session of frying.

Fragmentation pattern of the first peak gave molecular ion at m/e 574 as M^+ and might be a result of β -sitosterol oxidation (7 hydroxy β -sitosterol)

The second peak gave molecular ion at m/e 502 (M^+). This compound might be 5,6 epoxysitosterol.

Fragmentation data of the third peak showed its molecular ion at m/e at m/e 498 (M^+). Such peak might to be attributed to the oxidation of stigmasterol forming keto group.

The last peak had a M^+ at m/e 664 and this compound might be sitosterotriol.

Phytosterols levels decreased with repeated frying sessions, their deterioration being more prolonged during deep frying.

The oxidized sterols were increased steadily with repeated frying sessions compared with The Frist to the twelve frying session.

The main POPs in the samples were derived from sitosterol,

(7-hydroxy β–sitosterol - 5,6-epoxysitosterol – sitosteroltriol) and 7-ketostigmasterol .

Finally at the end of frying sessions sterols were highly destroyed compared with the zero and /or the twelve frying day either in the raw potatoes or French fries , conversely, the oxidized sterols were increased steadily.

CONCLUSION

According to aforementioned results, the results showed that frying session induces PS oxidation. In general, the longer the frying session, the more did PS oxidize. Phytosterols are basically stable compounds. However, under specific conditions, such as high temperature (>100 ◦C) in the presence of air, oxidation process of phytosterols may occur . Thermo-oxidation of PS can give rise to a number of products including ketones, alcohols, epoxides and dienes. Oxyphytosterols are absorbed by humans and their subsequent metabolic conversions may be of toxicological significance.. The food technologists have to be aware of the oxyphytosterols' level in food products The stalling of oil to the next day knows one of the most deterioration causing. Thus, the little quantities of oil during deep-frying are preferred.