

CHAPTER VI

RESULTS AND DISCUSSION

4.1 Physical Characteristics

According to Jahromi, et al. (2008) the shape and size are normally used to describe a seed, grain or fruit. Physical dimensions and shapes are vital factors when it comes to sorting and sizing of fruit. The date fruit characteristic such as fruit weight, length and width are importance in differentiation between the cultivars. Thus, these parameters were measured for 15 brands of dates and the results as shown in Table 3. Brand No.15 showed maximum weight, width and length (12.36 g, 5.20 cm and 5.98 cm) respectively. While brand No.10 had the smallest fruit weight, width and length (6.00 g, 1.22 cm and 2.34 cm) respectively.

TABLE 3: Physical Characteristics of date fruit for different brands

No.	Brand	Length (cm)	Width (cm)	Weigh (g)
1	Sedaghat	3.12 ±0.49	1.94 ±0.29	8.46 ±0.09
2	Sultan	2.94 ±0.35	1.88 ±0.43	9.94 ±0.34
3	Sajad	3.32 ±0.54	1.74 ±0.32	11.5 ±0.29
4	Royl	3.36 ±0.56	1.74 ±0.41	9.78 ±0.58
5	Shamim	3.38 ±0.32	2.16 ±0.19	11.4 ±0.92
6	Paradisa	3.20 ±0.41	2.04 ±0.32	12.2 ±0.45
7	Alsafa	3.70 ±0.50	1.54 ±0.26	6.28 ±0.66
8	Meera	3.38 ±0.34	1.60 ±0.23	6.14 ±0.52
9	Sun Fruit	3.82 ±1.08	1.36 ±0.60	6.50 ±0.59
10	Ajwa	2.34 ±0.28	1.22 ±0.35	6.00 ±0.74
11	Sugary	2.86 ±0.38	1.70 ±0.24	9.80 ±0.48
12	Rashodei	3.30 ±0.24	1.80 ±0.24	9.98 ±0.35
13	Sun seed	3.40 ±0.26	1.70 ±0.24	8.14 ±0.75
14	Sodat	3.96 ±0.47	2.60 ±0.30	9.78 ±0.46
15	Sultana	5.98 ±0.22	5.20 ±0.56	12.3 ±0.50

4.2 Minerals Content of dates

Element analysis of the dates fruit by using AAS showed that dates fruit contain many valuable and useful element like Potassium (K), Magnesium (Mg), Manganese (Mn), Ferum (Fe), Copper (Cu), Zinc (Zn) and Calcium (Ca). The results of minerals content of dates from different brands are presented in Table 4. The concentration of minerals was found similar to those expected results. Where K present is highest concentration in all different types of dates followed by Mg and Ca while Fe, Zn, Mn and Cu at lower concentration (Sawaya et al.,1983).

All 15 brands of the dates were significantly found different in their minerals levels. Brand No.11 had the highest concentration of Zn (4.84 ppm) whereas Brand No. 6 had the lowest concentration (0.30 ppm). Brand No.10 had the highest level of Cu (4.50 ppm), Fe (17.60 ppm),Mn (4.710 ppm) and Mg (352.5 ppm) while the lowest concentration of Cu showed in brand No.9 (0.54 ppm),the lowest concentration of Mg showed in brand No. 6 and brand No.15 (1.00 ppm) whereas the highest concentration of Ca showed in brand No.15 (320.0 ppm). Brand No.7 had the lowest concentration of Fe (7.10 ppm) and brand No.12.had the highest concentration of K (2023 ppm) whereas the lowest presented in brand No.11 (1443 ppm).

TABLE 4: Minerals content in dates from 15 different brands determined by using Atomic Absorption spectroscopy (AAS)

Brand No.	Zn	RSD	Cu	RSD	Fe	RSD	Mn	RSD	Mg	RSD	Ca	RSD	K	RSD
1	2.00	0.007	2.33	0.022	11.16	0.013	2.26	0.006	274.1	0.011	101.6	0.007	1930	0.002
2	2.17	0.012	2.03	0.012	8.35	0.013	2.25	0.006	200.8	0.007	175.8	0.008	1585	0.003
3	4.27	0.031	1.00	0.014	10.40	0.011	2.28	0.017	253.3	0.006	230.0	0.000	1751	0.001
4	3.13	0.045	3.14	0.039	8.38	0.015	2.04	0.019	259.1	0.006	252.5	0.010	1728	0.001
5	3.30	0.012	3.14	0.017	9.18	0.034	1.09	0.013	226.6	0.006	219.1	0.007	1859	0.002
6	0.30	0.000	1.85	0.008	10.99	0.022	1.00	0.014	248.0	0.006	257.7	0.015	1617	0.890
7	2.63	0.019	1.64	0.023	7.10	0.014	3.04	0.013	314.1	0.018	250.8	0.006	1525	0.016
8	0.75	0.019	2.28	0.006	16.40	0.018	2.02	0.012	290.8	0.013	131.6	0.022	1918	0.003
9	2.90	0.033	0.54	0.027	12.80	0.007	4.55	0.028	300.8	0.005	285.0	0.009	1929	0.002
10	4.18	0.007	4.50	0.039	17.60	0.008	4.71	0.003	352.5	0.007	130.5	0.004	1643	0.003
11	4.84	0.003	1.28	0.023	8.10	0.018	4.05	0.012	283.3	0.014	225.0	0.000	1443	0.002
12	2.85	0.010	1.65	0.009	13.10	0.011	4.41	0.020	278.3	0.005	275.5	0.017	2023	0.001
13	1.75	0.000	2.33	0.022	10.30	1.41	2.00	0.007	253.3	0.011	190.0	0.000	1882	0.001
14	3.00	0.012	3.03	0.010	8.59	0.002	1.76	0.008	279.1	0.005	264.1	0.006	1758	0.000
15	3.06	0.005	3.33	0.000	8.64	7.600	1.00	0.000	226.6	0.640	320.0	0.000	1675	0.000

Where

Concentration of minerals in ppm

RSD = Relative Standard Deviation

4.3 Principle Component Analysis (PCA) of Dates

4.3.1 Physical Characteristics

In this study the multivariates of row data matrix which consist of 15 different brands of dates were subjected to PCA . PCA was performed using three paramaters (weight, length and width). Loadings and scores matrixes were obtained as summarized in Table 5 and Table 6 respectively.

TABLE 5: Loadings of 3 significant Principal Components (PCs)

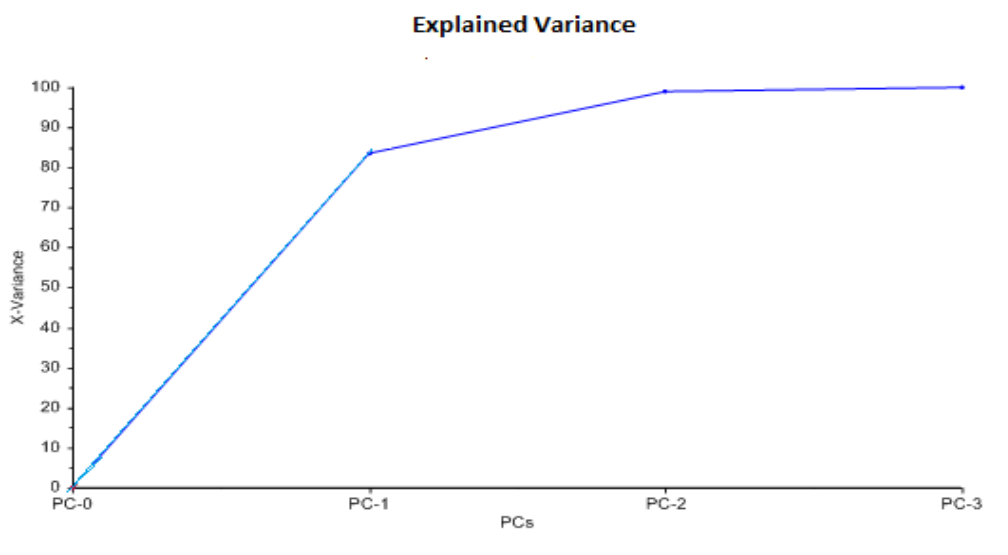
Variables	PC-1	PC-2	PC-3
Length	0.16	0.68	0.71
Width	0.28	0.66	-0.7
Weight	0.95	-0.31	0.08
Eigenvalue %	63.5	70.6	40.7

TABLE 6 : Scores of 3 significant Principal Components (PCs)

Brand No	PC-1	PC-2	PC-3
1	-0.80	-0.05	-0.26
2	0.56	-0.67	-0.22
3	2.05	-0.99	0.28
4	0.43	-0.43	0.16
5	2.14	-0.66	0.02
6	2.82	-1.14	0.04
7	-2.88	0.76	0.25
8	-3.05	0.62	-0.04
9	-2.71	0.65	0.48
10	-3.46	-0.30	-0.52
11	0.36	-0.80	-0.17
12	0.63	-0.49	0.09
13	-1.13	0.08	0.08
14	0.77	0.55	-0.01
15	4.26	2.85	-0.17
Eigenvalue %	83.0	16.0	1.00

The data set is explained by 3 principle components as shown in Figure 3.

FIGURE 3: Explained variance from 15 different brands of dates for physical Characteristics



PC1 accounts to 83 % variance of PCA model contributes to width and length. Dates brand No 3, 5, and 6 are grouping together in class 3. These scores had positive values characterized by weight as presented in Figure 4. Loading plots showed the weight is anti-correlated with width and length. Brand No. 15 had maximum value on these parameters and form its own class 1. PC2 accounts to 16 % of PCA model significantly contributed by brand No. 7, 8, 9, and 10 characterized by length and width parameter and form class 4, where brand No. 10 was the smallest one. Loadings plot showed weight was characterized by brand No. 15 as displayed in Figure 5.

From scores plot brand No. 1, 2, 4, 11, 12, 13 and 14 were distributed near center that to form class 2 which between class 3 and class 4.

FIGURE 4 : Scores plot of PCA from 15 different brands of dates for physical Characteristics

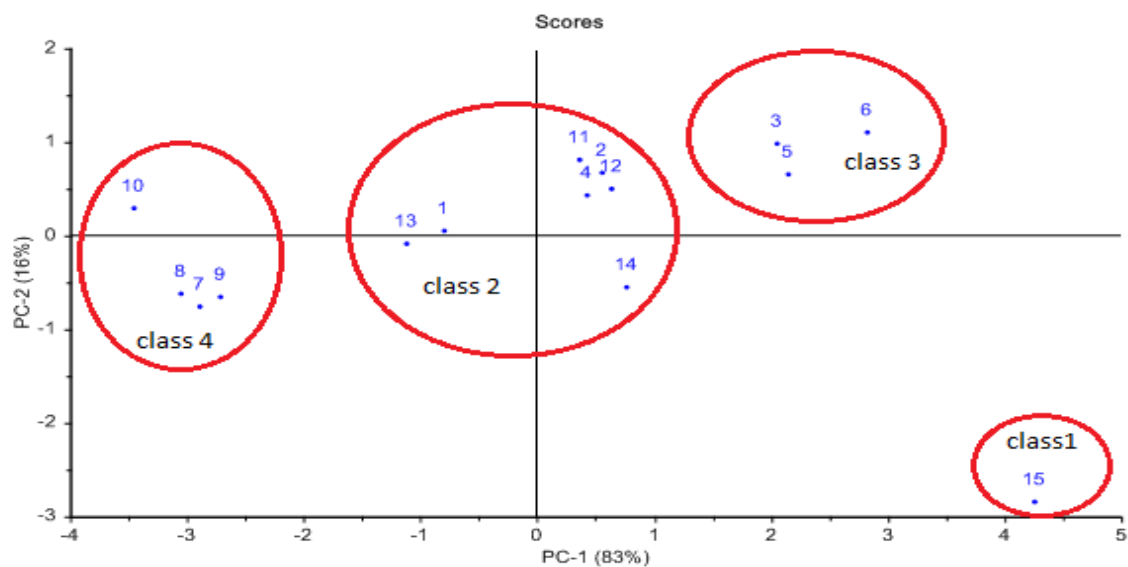
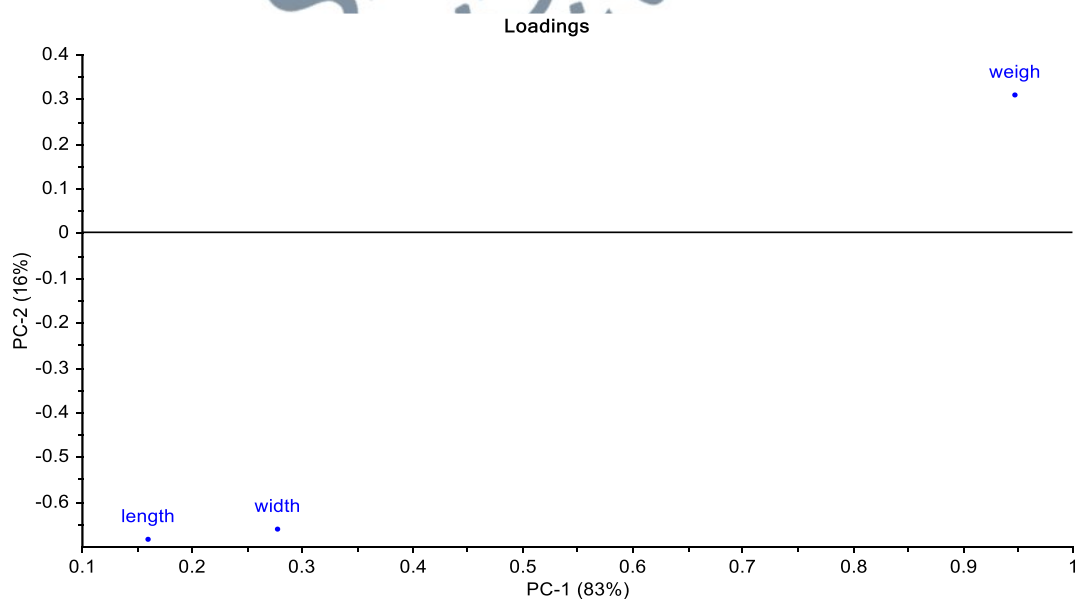


FIGURE 5 : Loadings plot of PCA from 15 different brands of dates for physical Characteristics



4.3.4 Minerals Composition

The multivariates of standardized data matrix of 15 different brands of dates were subjected to PCA in order to reduce the number of descriptors associated with the data set. Loadings and scores matrix were obtained by using mineral composition as variables as shown in Table 7 and Table 8 respectively.

TABLE 7: Loadings of 4 significant Principal Components (PCs)

Variables	PC-1	PC-2	PC-3	PC-4
Zn	0.00	-0.04	0.12	-0.99
Cu	0.00	0.00	0.00	0.01
Fe	-0.01	-0.03	-0.03	0.02
Mn	0.00	-0.01	-0.02	-0.02
Mg	0.02	-0.48	-0.87	-0.09
Ca	0.06	0.88	-0.47	-0.10
K	-1.00	0.04	-0.04	-0.01
Eigenvalues %	80.9	60.9	40.3	70.5

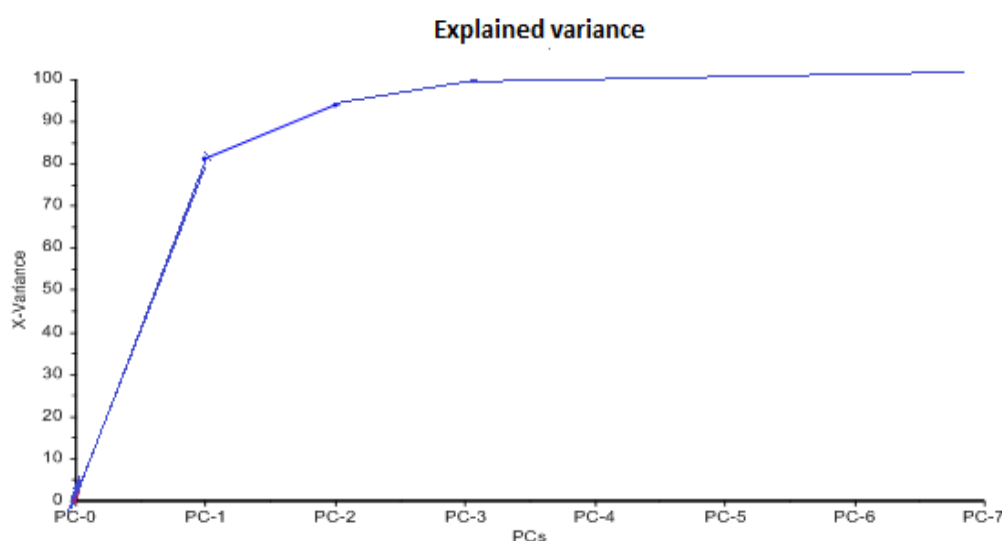
Loadings showed that Mg, Ca and K had significant values either (+ ve / - ve) compared to other minerals.

TABLE 8: Scores of 4 significant Principal Components (PCs)

Brand No	PC-1	PC-2	PC-3	PC-4
1A	-7.523	-3.975	1.815	0.561
1B	-7.524	-3.881	2.088	-0.418
1C	-7.226	-3.981	2.247	-1.402
2A	6.271	-0.556	3.951	-2.345
2B	6.461	-0.471	3.726	0.642
2C	6.661	-0.479	3.735	0.644
3A	0.036	0.667	0.504	0.111
3B	-0.066	0.719	0.588	0.109
3C	0.034	0.714	0.592	0.112
4A	0.887	1.378	0.026	0.056
4B	0.995	1.415	-0.105	0.046
4C	1.083	1.235	-0.007	0.064
5A	-4.204	0.929	1.521	0.256
5B	-4.498	1.028	1.461	0.242
5C	-4.4	1.071	1.552	0.255
6A	6.12	2.174	0.199	0.166
6B	5.112	1.987	0.155	0.168
6C	5.106	1.904	0.211	0.179
7A	9.112	-0.185	-1.68	-0.056
7B	8.114	-0.145	-1.722	-0.067
7C	10.108	0.052	-1.335	-0.025
8A	-7.054	-3.179	0.932	0.471
8B	-6.952	-3.231	0.848	0.462
8C	-6.538	-3.167	0.597	0.429
9A	-6.802	1.93	-2.357	-0.255
9B	-6.994	1.978	-2.501	-0.269
9C	-7.09	2.117	-2.463	-0.278
10A	4.329	-6.23	-3.405	-0.063
10B	4.327	-6.264	-3.386	-0.059
10 C	4.026	-6.205	-3.312	-0.051
11A	12.228	-0.623	-0.02	0.08
11B	12.222	-0.48	0.243	0.105
11C	12.424	-0.536	0.164	0.098
12A	-10.638	2.027	-1.584	-0.167
12B	-10.622	2.347	-1.643	-0.184
12C	-10.72	2.386	-1.666	-0.187
13A	-5.344	-0.515	1.02	0.32
13B	-5.344	-0.516	1.019	0.32
13C	-5.248	-0.424	1.199	0.338
14A	-0.168	1.479	-0.955	-0.06
14B	-0.172	1.344	-0.995	-0.061
14C	-0.166	1.431	-1.042	-0.07
15A	3.213	4.228	-0.1	-0.077
15B	3.213	4.228	-0.1	-0.077
15C	3.211	4.276	-0.013	-0.067
Eigenvalues %	81.0	13.0	6.00	0.00

The accumulation percentage of eigenvalue for 7 principle components indicated that, the data set is explained by 3 principle components as shown in Figure 6. This means that Mg, Ca, K are the variables those contribute to PC model.

FIGURE 6: Explained variance 15 different dates brand for minerals content



PC1 accounts to 81 % variance of PCA model contributes by K (- 1.00). PC2 contribute by Ca (0.88) and Mg (-0.48). Scores plot in Figure 7 and loadings plot in Figure 8 explained that, brand No.10 showed most contributes to Mg, brand No. 15 showed most contributes to Ca and brand No. 12 most contributes to K mineral. While brand No.3, 4 and 14 were close together in the middle of the plot. Class 1 which the PC values around 0. Brand No. 1, 5, 8, 9, 12 and 13 classified as class 2 which the PC values were negative. On other hand, brand No. 2, 6, 7, 11 and 15 are group together in Class 3. These brands had positive values for PC 1. Brand No. 10 classified as class 4 which PC 2 value was the highest negative value (- 6.2).

FIGURE 7: Scores plot of PCA from 15 different brands of dates by using AAS

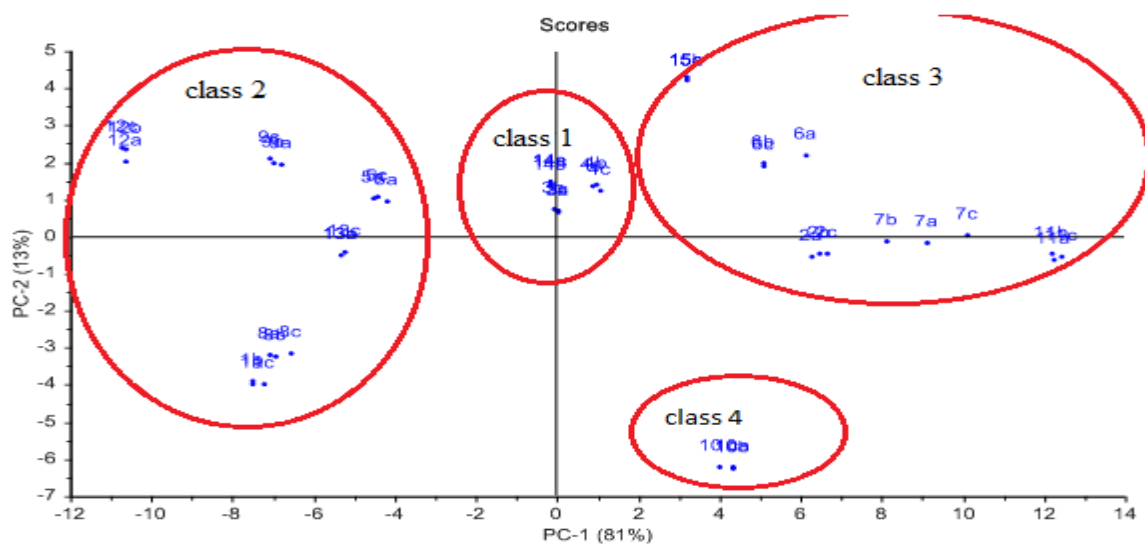
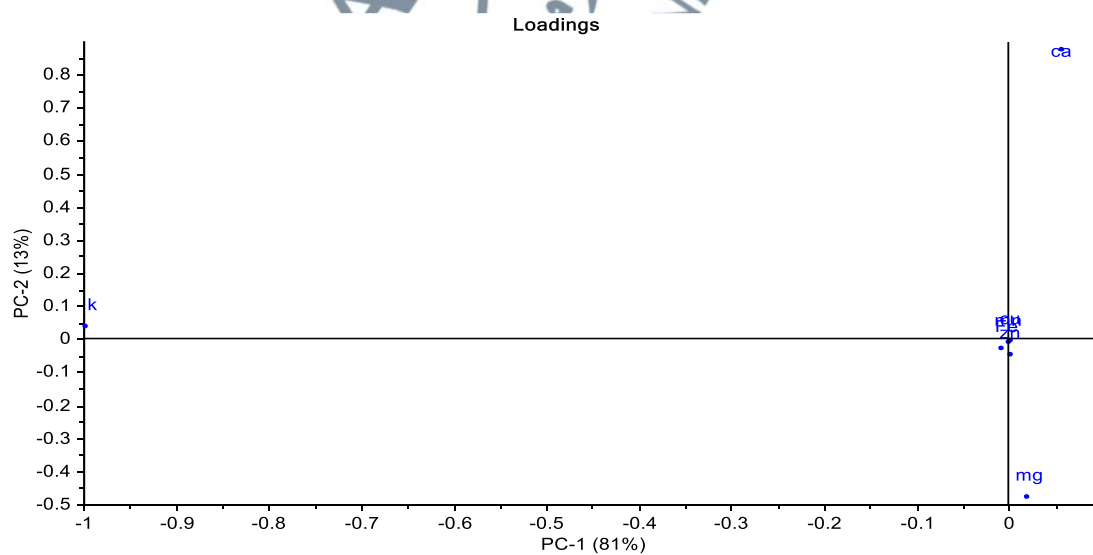


FIGURE 8: Loadings plot of PCA from 7 minerals by using AAS



4.4 K-means Cluster of dates

4.4.1 Physical Characteristics

The *k*-means cluster analysis on physical measurements data for 15 different brands of dates classified all samples into 4 different classes as displayed in Table 9 based on three characteristics weight, length and width and this can be related to scores plot in Figure 4. Class 1 is formed by brand No. 15 where the date had maximum width and weight, while class 2 is formed by brand No. 1, 2, 4, 11, 12, 13 and 14 had average in width and weight. Class 3 is formed by brand No. 3, 5, 6 which had maximum weight and class 4 is formed by brand No. 7, 8, 9 and 10 that had less weight.

TABLE 9 : *K*- means cluster from 15 different brands of dates according to physical Characteristics

Brand No.	Characteristic	Class
15	Maximum width and weight	1
1, 2, 4, 11, 12, 13 and 14	Average in width and weight	2
3, 5, 6	Maximum weight	3
7, 8, 9 and 10	Less weight	4

4.4.2 Minerals Composition

The *k*-means cluster analysis on minerals content for 15 different dates classified all samples into 4 different classes as shown in Table 10. And this can be related to scores plot in Figure 7. Class 1 is formed by brand No. 3, 4 and 14 where the dates had average concentration of Mn (1.00 ppm- 4.71 ppm), Fe (7.10 ppm-17.6 ppm), Cu (0.54 ppm-3.33 ppm) and Zn (0.30 ppm-4.84 ppm) while Class 2 is formed by brand

No. 1, 5, 8, 9, 12 and 13 where the dates have the highest concentration of K (2023 ppm). Class 3 is formed by brand No. 2, 6, 7, 11 and 15 where the dates have the highest concentration of Ca (320.0 ppm) and Class 4 is formed by brand No. 10 where the dates have the highest concentration of Mg (352.5 ppm).

TABLE 10 : *K- means* cluster results from 15 different brands of dates according to Minerals content

Brand No	Characteristic	Class
3, 4 and 14	Mn, Fe, Cu & Zn (in average)	1
1, 5, 8, 9, 12 and 13	K	2
2, 6, 7, 11 and 15	Ca	3
10	Mg	4