RESULTS AND DISCUSSION

RESULTS AND DISCUTION

Artificial feeding is very important for bees, as evidenced by directions in case of insufficient winter stores when the bees can not obtain enough nectar and pollen. The artificial feeding with pollen substitutes are stimulating the brood rearing in order to increase the population in anticipation of spring activity of honeybee colonies, mainly because it's flowers are available. Therefore these experiments were carried out to study the correspondence between different pollen substitutes and their activities on brood rearing, pollen gathering, queen cups building, pollen substitutes consumption, hypopharyngeal gland development, biometrical characters of wax mirror and longevity during study period as follows.

1. Brood rearing:

1.1. Effect of pollen substitutes feeding during different seasons on brood rearing activity in honeybee colonies:

1.1.1. First year (2003-2004):

The data recorded in table (1) and fig. (5) during the four seasons showed the following:

- **Autumn:**

The mean of sealed brood area during autumn season was 150.19, 171.1, 170.29, 124.67 and 130.14 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Table (1): The effect of feeding different pollen substitutes on the area of sealed worker brood (inch²/colony) during four seasons (2003-2004).

Season	Date	Treatments					L.S.D.	
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control	0.05	0.01
Autumn	25/09/2003	265.00	279.33	293.67	251.67	287.00	12.26	17.44
	08/10/2003	235.33	266.33	274.33	224.33	225.67		
	21/10/2003	178.33	215.00	197.67	151.67	134.33		
	03/11/2003	162.00	162.67	157.33	97.00	94.67		
	16/11/2003	100.33	122.33	127.00	58.33	72.67		
	29/11/2003	61.00	74.00	82.67	48.00	49.00		
	12/12/2003	49.33	78.00	59.33	41.67	47.67		
	Total	**1051.33**	**1197.67**	**1192.00**	**872.67**	**911.00**		
	Mean	**150.19b**	**171.10a**	**170.29**	**124.67**	**130.14**		
Winter	25/12/2003	34.33	71.67	65.33	39.33	34.67	12.39	17.63
	07/01/2004	57.33	72.33	67.00	27.33	30.00		
	20/01/2004	67.33	114.00	96.33	43.00	46.67		
	02/02/2004	88.67	175.67	138.67	54.00	82.00		
	15/02/2004	167.67	208.67	169.00	100.67	81.33		
	28/02/2004	238.00	283.33	216.00	125.33	92.33		
	12/03/2004	250.67	328.00	272.67	112.00	116.33		
	Total	**904.00**	**1253.67**	**1025.00**	**501.67**	**483.33**		
	Mean	**129.14**	**179.10**	**146.43**	**71.67**	**69.05**		
Spring	25/03/2004	223.67	338.00	231.00	105.00	137.00	40.86	58.12
	07/04/2004	232.67	344.67	305.67	154.67	174.33		
	20/04/2004	227.00	309.67	304.67	205.00	202.33		
	03/05/2004	270.00	331.67	310.33	248.33	258.00		
	16/05/2004	293.33	374.00	320.67	257.00	255.33		
	29/05/2004	273.67	381.00	299.67	260.00	248.00		
	11/06/2004	286.00	392.00	327.00	308.00	315.67		
	Total	**1806.33**	**2471.00**	**2099.00**	**1538.00**	**1590.67**		
	Mean	**258.05**	**353.00**	**299.86**	**219.71**	**227.24**		
Summer	24/06/2004	268.67	340.00	343.33	263.33	270.67	17.20	24.47
	07/07/2004	312.33	312.33	328.67	220.67	258.33		
	20/07/2004	262.33	284.33	289.33	199.00	239.33		
	02/08/2004	206.33	256.33	270.67	167.67	221.00		
	15/08/2004	142.33	253.00	240.67	119.00	169.00		
	28/08/2004	177.33	258.00	218.67	137.67	175.33		
	10/09/2004	160.00	220.67	202.67	182.33	156.67		
	Total	**1529.33**	**1924.67**	**1894.00**	**1289.67**	**1490.33**		
	Mean	**218.48**	**274.95**	**270.57**	**184.24**	**212.90**		
Total year		**5291.00**	**6847.00**	**6210.00**	**4202.00**	**4475.33**	**11.81**	**16.80**

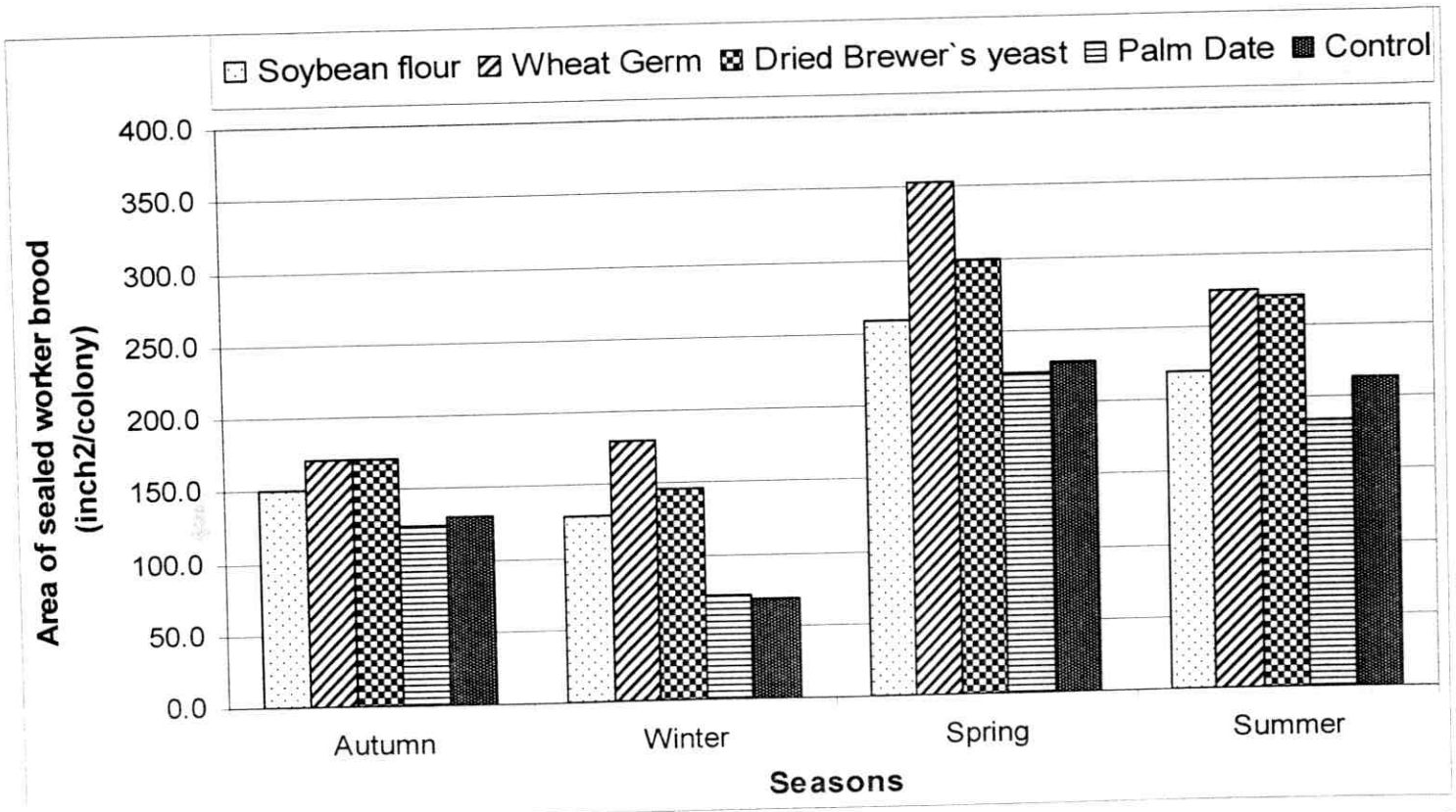

Fig. (5): The effect of feeding different pollen substitutes on the area of sealed worker brood (inch²/colony) in honey bee colonies during four seasons (2003-2004).

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, but there were highly significant differences between Wheat Germ, Dried Brewer's yeast and all other treatments (Soybean flour, Control and Palm Date).

- **Winter:**

The mean of sealed brood area during winter season was 129.14, 179.1, 146.43, 71.67 and 69.05 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were highly significant differences between Wheat Germ and all other treatments (Dried Brewer's yeast, Soybean flour, Palm Date and Control).

- **Spring:**

The mean of sealed brood area during spring season was 258.05, 353, 299.86, 219.71 and 227.24 inch²/ colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were significant differences between Wheat Germ and Dried Brewer's yeast, but there were highly significant differences between Wheat Germ and each of Soybean flour, Control and Palm Date.

- **Summer:**

The mean of sealed brood area during summer season was 218.48, 274.95, 270.57, 184.24 and 212.9 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were significant differences between Wheat Germ, Dried Brewer's yeast and all other treatments.

From the data tabulated in table (1) showed that the total of sealed brood area measured from each treatment of Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control during the first year were 5291, 6847, 6210, 4202 and 4475.33 $inch^2$/ colony, respectively.

Statistical analysis from the data recorded in table (1) indicated that there were highly significant differences between Wheat Germ and all other treatments (Dried Brewer's yeast, Soybean flour, Control and Palm Date), respectively. While there were insignificant differences between Control and Palm Date.

1.1.2. Second year (2004-2005):

The data recorded in table (2) and fig. (6) during the four seasons showed the following:

- **Autumn:**

The mean of sealed brood area during autumn season were 116.86, 153.24, 131.81, 90.95 and 90.62 $inch^2$/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were significant differences between Wheat Germ and Dried Brewer's yeast, but there were highly significant differences between Wheat Germ and each of Soybean flour, Palm Date and Control.

Table (2): The effect of feeding different pollen substitutes on the area of sealed worker brood (inch²/colony) during four seasons (2004-2005).

Season	Date	Treatments					L.S.D.	
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control	0.05	0.01
Autumn	23/09/2004	171.33	253.33	191.67	165.67	125.00	19.74	28.07
	06/10/2004	161.00	222.00	186.00	126.33	104.00		
	19/10/2004	156.00	145.00	110.67	92.67	88.67		
	01/11/2004	78.67	130.67	106.67	59.33	89.00		
	14/11/2004	92.00	120.00	156.00	78.33	116.33		
	27/11/2004	89.67	114.67	102.00	69.67	75.33		
	10/12/2004	69.33	87.00	69.67	44.67	36.00		
	Total	**818.00**	**1072.67**	**922.67**	**636.67**	**634.33**		
	Mean	**116.86**	**153.24**	**131.81**	**90.95**	**90.62**		
Winter	23/12/2004	52.33	74.00	58.67	28.33	27.00	18.35	26.10
	05/01/2005	71.33	91.67	63.00	29.00	51.33		
	18/01/2005	113.33	102.67	82.33	39.33	59.67		
	31/01/2005	168.67	168.67	164.67	39.33	67.33		
	13/02/2005	162.67	237.00	201.33	53.00	84.33		
	26/02/2005	243.00	283.00	273.33	79.33	66.33		
	11/03/2005	218.33	357.33	227.67	93.67	97.33		
	Total	**1029.67**	**1314.33**	**1071.00**	**362.00**	**453.33**		
	Mean	**147.10**	**187.76**	**153.00**	**51.71**	**64.76**		
Spring	24/03/2005	269.00	390.33	261.33	138.67	177.00	37.18	52.89
	06/04/2005	244.00	384.33	282.33	140.00	177.33		
	19/04/2005	263.00	308.67	300.67	149.33	196.67		
	02/05/2005	260.67	349.67	350.67	217.67	226.67		
	15/05/2005	321.33	395.00	370.67	287.00	353.67		
	28/05/2005	295.67	364.00	336.00	264.33	291.33		
	10/06/2005	258.67	346.33	228.67	207.00	244.33		
	Total	**1912.33**	**2538.33**	**2130.33**	**1404.00**	**1667.00**		
	Mean	**273.19**	**362.62**	**304.33**	**200.57**	**238.14**		
Summer	23/06/2005	221.33	331.33	254.33	249.00	230.33	24.96	35.50
	06/07/2005	242.00	334.00	251.67	238.33	248.67		
	19/07/2005	232.33	276.67	225.00	178.00	228.00		
	01/08/2005	249.67	262.00	245.00	156.67	211.00		
	14/08/2005	233.00	222.33	264.67	146.33	220.00		
	27/08/2005	218.33	211.00	227.67	157.00	196.67		
	09/09/2005	213.00	282.67	198.67	165.33	123.33		
	22/09/2005	229.00	287.33	204.67	114.33	145.67		
	Total	**1838.67**	**2207.33**	**1871.67**	**1405.00**	**1603.67**		
	Mean	**229.83**	**275.92**	**233.96**	**175.63**	**200.46**		
Total year		**5598.67**	**7132.67**	**5995.67**	**3807.67**	**4358.33**	**19.11**	**27.18**

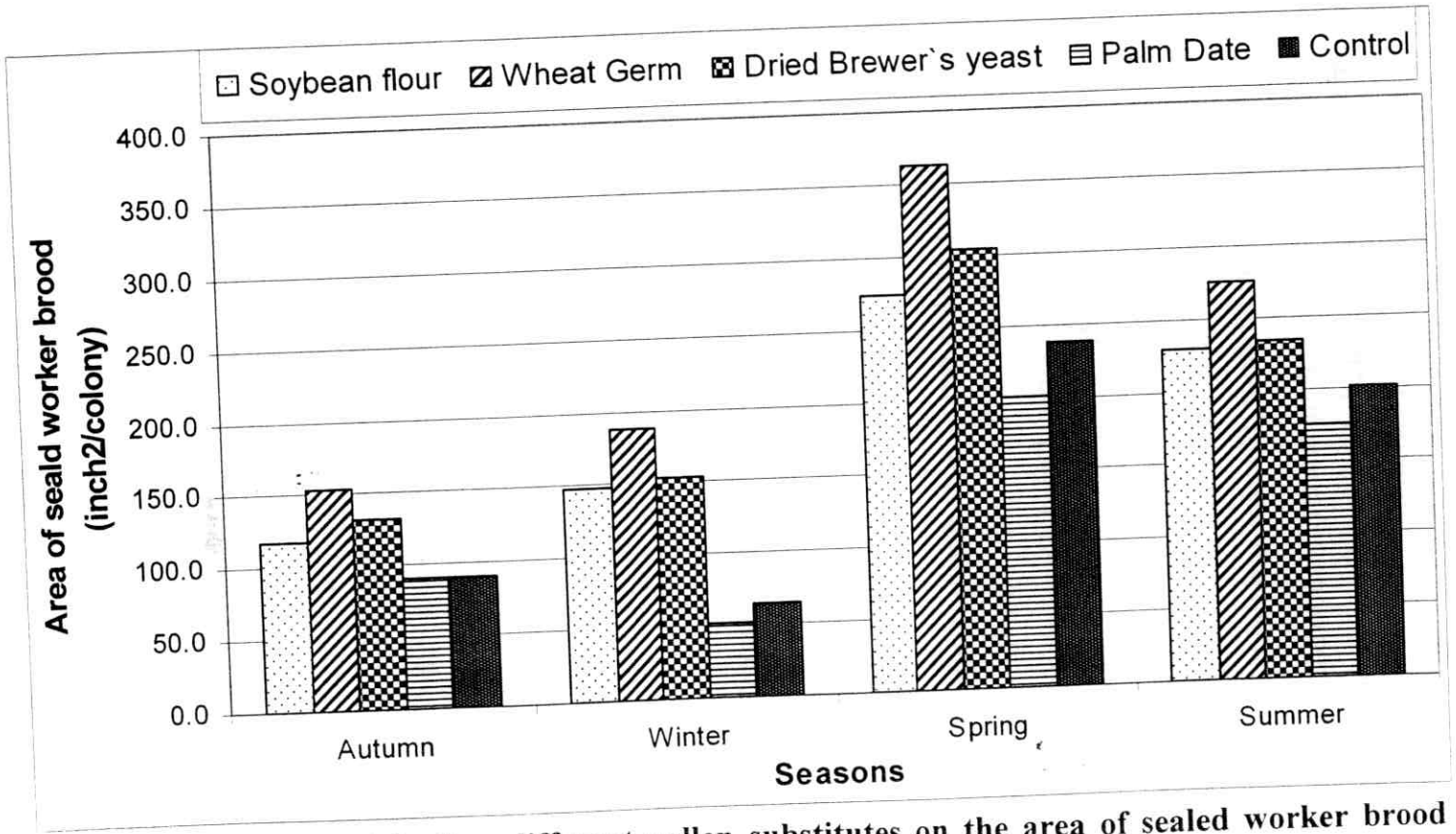

Fig. (6): The effect of feeding different pollen substitutes on the area of sealed worker brood (inch²/colony) in honey bee colonies during four seasons (2004-2005).

- **Winter:**

The mean of sealed brood area during winter season were 147.1, 187.76, 153, 51.71 and 64.76 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were highly significant differences between Wheat Germ and all other treatments (Dried Brewer's yeast, Soybean flour, Control and Palm Date).

- **Spring:**

The mean of sealed brood area during spring season were 273.19, 362.62, 304.33, 200.57 and 238.14 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were highly significant differences between Wheat Germ and all other treatments (Dried Brewer's yeast, Soybean flour, Control and Palm Date).

- **Summer:**

The mean of sealed brood area during summer season were 229.83, 275.92, 233.96, 175.63 and 200.46 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were highly significant differences between Wheat Germ and all other treatments (Dried Brewer's yeast, Soybean flour, Control and Palm Date).

From the data tabulated in table (2) showed that the total of sealed brood area measured from each treatment of (Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and

Control) during the second year were 5598.67, 7132.67, 5995.67, 3807.67 and 4358.33 inch²/ colony, respectively.

Statistical analysis from the data recorded in table (2) indicated that there were highly significant differences between Wheat Germ and all other treatments (Dried Brewer's yeast, Soybean flour, Control and Palm Date). While there were insignificant differences between Dried Brewer's yeast and Soybean flour, and between Control and Palm Date.

The results in tables (1, 2) and figures (5, 6) cleared that the highest amount of brood production in the spring season, this may be due to abundance of nectar and pollen plant sources , feeding with pollen substitutes are stimulation to increase of brood rearing and the favorable weather factors. While the lowest amount of brood production in the autumn season, this may be due to fluctuations of the weather factors and shortage of nectar and pollen plant sources.

Also these results indicated that (Wheat Germ) gave the highest amount of brood production, while (Palm Date) gave the lowest amount during study period.

1.2. Effect of pollen substitutes feeding during different months on brood rearing activity in honeybee colonies:

From the results recorded in table (3) and Fig. (7) showed that the mean amount of brood production during the first year was increased gradually beginning of February (148.09 inch²/colony) and reached the highest rates in June (311.47 inch²/colony), then decreased gradually to reach the lowest rates in December (52.13 inch²/colony). While the mean amount of brood production during the second year was increased gradually beginning of

Table (3): Effect of feeding pollen substitutes during different months on brood rearing activities in two years of study in (inch²/colony).

years	Months	Treatments					Total	Mean
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control		
First year	January	62.33	93.17	81.67	35.17	38.33	**310.67**	**62.13**
	February	164.78	222.56	174.56	93.33	85.22	**740.44**	**148.09**
	March	237.17	333.00	251.83	108.50	126.67	**1057.17**	**211.43**
	April	229.83	327.17	305.17	179.83	188.33	**1230.33**	**246.07**
	May	279.00	362.22	310.22	255.11	253.78	**1460.33**	**292.07**
	June	277.33	366.00	335.17	285.67	293.17	**1557.33**	**311.47**
	July	287.33	298.33	309.00	209.83	248.83	**1353.33**	**270.67**
	August	175.33	255.78	243.33	141.44	188.44	**1004.33**	**200.87**
	September	165.67	237.00	197.17	174.00	140.83	**914.67**	**182.93**
	October	206.83	240.67	236.00	188.00	180.00	**1051.50**	**210.30**
	November	107.78	119.67	122.33	67.78	72.11	**489.67**	**97.93**
	December	41.83	74.83	62.33	40.50	41.17	**260.67**	**52.13**
Second year	January	117.78	121.00	103.33	35.89	59.44	**437.44**	**87.49**
	February	202.83	260.00	237.33	66.17	75.33	**841.67**	**168.33**
	March	243.67	373.83	244.50	116.17	137.17	**1115.33**	**223.07**
	April	253.50	346.50	291.50	144.67	187.00	**1223.17**	**244.63**
	May	292.56	369.56	352.44	256.33	290.56	**1561.44**	**312.29**
	June	240.00	338.83	241.50	228.00	237.33	**1285.67**	**257.13**
	July	237.17	305.33	238.33	208.17	238.33	**1227.33**	**245.47**
	August	233.67	231.78	245.78	153.33	209.22	**1073.78**	**214.76**
	September	221.00	285.00	201.67	139.83	134.50	**982.00**	**196.40**
	October	158.50	183.50	148.33	109.50	96.33	**696.17**	**139.23**
	November	86.78	121.78	121.56	69.11	93.56	**492.78**	**98.56**
	December	60.83	80.50	64.17	36.50	31.50	**273.50**	**54.70**

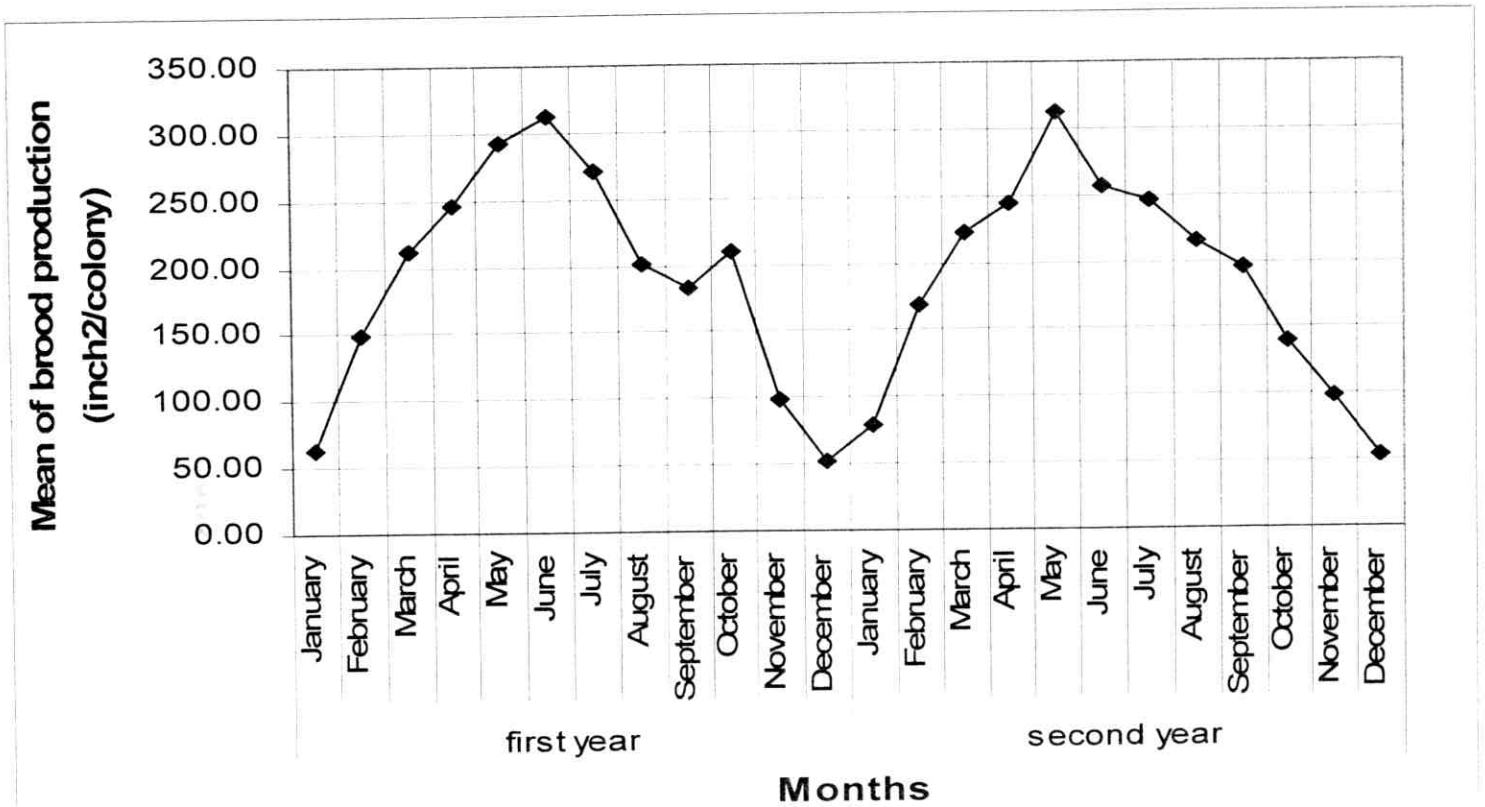

Fig. (7): The effect of pollen substitutes during different months on brood rearing activities in two years of study in (inch²/colony).

February (168.33 inch²/colony) and reached the highest rates in May (312.29 inch²/colony), then decreased gradually to reach the lowest rates in December (54.70 inch²/colony).

The above results are supported by **Mahrous (1962)** who observed that the use of pollen supplements increased colony population. **Brar *et al.* (1992)** found that the colonies continued brood rearing throughout the year with the major peak occurring during March-May at all the locations. A second peak, though of low magnitude, also occurred during November. **Mishref *et al.* (1995)**, **El-Shaarawi (2001)**, **El-Waseef (2002)**, **Kalev *et al.* (2002)** and **Serag El-Dien And Eissa (2003)** whose studies indicated that the honeybee colonies provided with pollen substitutes reared more worker brood than in case of unfed ones (Control colonies) during the observation period.

2. Pollen gathering:

2.1. Effect of pollen substitutes feeding during different seasons on pollen gathering activity in honeybee colonies:

2.1.1. First year (2003-2004):

The data recorded in table (4) and fig. (8) during the four seasons showed the following:

- **Autumn:**

The mean of stored pollen area during autumn season were 28.29, 28.57, 30.67, 26.57 and 25.62 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Table (4): The effect of feeding different pollen substitutes on the area of stord pollen (inch²/colony) in honey bee colonies during four seasons (2003-2004).

Season	Date	Treatments					L.S.D.	
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control	0.05	0.01
Autumn	25/09/2003	39.00	35.00	46.67	42.00	32.00	2.37	3.37
	08/10/2003	28.00	26.67	32.67	30.67	25.33		
	21/10/2003	28.67	24.33	28.00	30.00	22.33		
	03/11/2003	24.00	26.00	24.00	24.67	24.33		
	16/11/2003	29.00	33.33	31.33	27.33	25.33		
	29/11/2003	26.00	29.67	30.67	19.00	29.67		
	12/12/2003	23.33	25.00	21.33	12.33	20.33		
	Total	**198.00**	**200.00**	**214.67**	**186.00**	**179.33**		
	Mean	**28.29**	**28.57**	**30.67**	**26.57**	**25.62**		
Winter	25/12/2003	22.67	18.00	15.33	8.00	8.33	2.84	4.03
	07/01/2004	14.00	12.00	18.00	8.33	7.33		
	20/01/2004	15.67	18.33	16.33	10.67	10.00		
	02/02/2004	21.33	22.00	25.00	13.33	14.00		
	15/02/2004	11.33	23.00	15.00	15.33	11.67		
	28/02/2004	18.33	23.00	17.67	16.00	9.33		
	12/03/2004	24.33	24.00	24.33	21.33	23.33		
	Total	**127.67**	**140.33**	**131.67**	**93.00**	**84.00**		
	Mean	**18.24**	**20.05**	**18.81**	**13.29**	**12.00**		
Spring	25/03/2004	34.00	29.33	22.67	28.00	22.00	6.41	9.12
	07/04/2004	39.00	36.67	25.33	35.33	29.67		
	20/04/2004	30.67	58.00	42.67	33.33	24.00		
	03/05/2004	54.67	80.00	55.00	36.67	47.33		
	16/05/2004	84.00	94.67	83.33	58.33	69.00		
	29/05/2004	108.67	118.33	95.00	81.67	86.67		
	11/06/2004	85.33	83.33	123.33	51.33	71.67		
	Total	**436.33**	**500.33**	**447.33**	**324.67**	**350.33**		
	Mean	**62.33**	**71.48**	**63.90**	**46.38**	**50.05**		
Summer	24/06/2004	75.33	68.33	76.00	38.00	53.00	12.42	17.67
	07/07/2004	60.67	78.33	70.67	50.67	67.00		
	20/07/2004	59.33	97.33	76.00	54.67	67.33		
	02/08/2004	98.33	123.33	98.33	89.00	51.33		
	15/08/2004	75.00	96.67	96.67	84.33	78.33		
	28/08/2004	71.67	66.67	83.33	43.00	71.67		
	10/09/2004	53.67	55.33	66.67	30.33	58.33		
	Total	**494.00**	**586.00**	**567.67**	**390.00**	**447.00**		
	Mean	**70.57**	**83.71**	**81.10**	**55.71**	**63.86**		
Total year		**1256.00**	**1426.67**	**1361.33**	**993.67**	**1060.67**	2.84	4.04

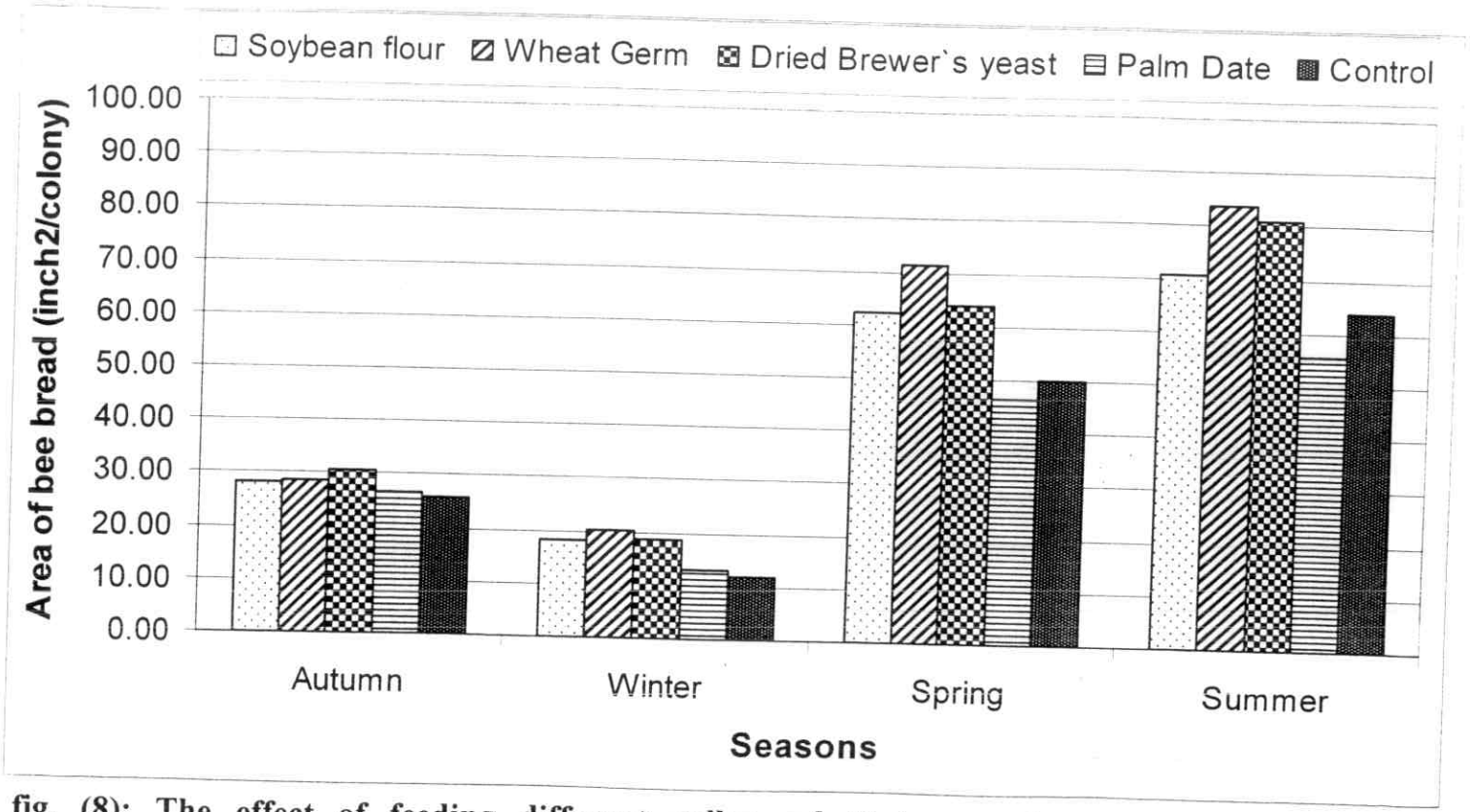

fig. (8): The effect of feeding different pollen substitutes on the area of stored pollen (inch²/colony) in honey bee colonies during four seasons (2003-2004).

Statistical analysis indicated that there were insignificant differences between Dried Brewer's yeast and Wheat Germ, while, there were significant differences between Dried Brewer's yeast and each of Soybean flour, Palm Date and Control.

- **Winter:**

The mean of stored pollen area during winter season were 18.24, 20.05, 18.81, 13.29 and 12 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences among Wheat Germ, Dried Brewer's yeast and Soybean flour, but there were highly significant differences between the above mentioned three treatments and (Palm Date and Control).

- **Spring:**

The mean of stored pollen area during spring season were 62.33, 71.48, 63.90, 46.38 and 50.05 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were significant differences between Wheat Germ and both diets Dried Brewer's yeast and Soybean flour, while there were highly significant differences between Wheat Germ and both of Control and Palm Date.

- **Summer:**

The mean of stored pollen area during summer season were 70.57, 83.71, 81.1, 55.71 and 63.86 inch²/colony for Soybean

flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were significant differences between Wheat Germ and each of Soybean flour, Control and Palm Date.

The data tabulated in table (4) showed that the total of stored pollen area measured from each treatment of (Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control) during the first year were 1256, 1426.67, 1361.33, 993.67 and 1060.67 inch²/colony, respectively.

Statistical analysis of the data recorded in table (4) indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were highly significant differences between Wheat Germ and each of Soybean flour, Control and Palm Date.

2.1.2. Second year (2004-2005):

The data recorded in table (5) and fig. (9) during the four seasons showed the following:

- **Autumn:**

The mean of stored pollen area during autumn season were 35, 38.62, 42.52, 28.48 and 36.48 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between Dried Brewer's yeast and Wheat Germ, but

Total (5): The effect of feeding different pollen substitutes on the area of stored pollen (inch²/colony) in honey bee colonies during four seasons (2004-2005).

Season	Date	Treatments					L.S.D.	
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control	0.05	0.01
Autumn	23/09/2004	54.67	33.00	54.00	37.67	61.00	6.25	8.89
	06/10/2004	42.67	31.67	37.67	27.33	34.67		
	19/10/2004	35.33	41.67	46.67	16.00	19.67		
	01/11/2004	36.33	62.33	53.67	36.67	32.67		
	14/11/2004	39.00	51.33	56.33	46.33	56.67		
	27/11/2004	21.33	29.33	30.00	25.00	27.00		
	10/12/2004	15.67	21.00	19.33	10.33	23.67		
	Total	**245.00**	**270.33**	**297.67**	**199.33**	**255.33**		
	Mean	**35.00**	**38.62**	**42.52**	**28.48**	**36.48**		
Winter	23/12/2004	16.33	19.67	6.33	10.67	18.00	5.12	7.29
	05/01/2005	25.33	20.67	37.33	13.33	14.67		
	18/01/2005	22.00	17.33	25.33	9.00	13.00		
	31/01/2005	21.67	17.67	26.33	6.00	10.33		
	13/02/2005	16.67	14.33	13.33	2.00	7.00		
	26/02/2005	36.67	32.33	28.33	7.33	25.33		
	11/03/2005	28.33	22.33	26.33	10.33	8.00		
	Total	**167.00**	**144.33**	**163.33**	**58.67**	**96.33**		
	Mean	**23.86**	**20.62**	**23.33**	**8.38**	**13.76**		
Spring	24/03/2005	29.00	40.33	19.33	26.33	27.33	13.52	19.24
	06/04/2005	21.67	27.67	12.00	29.00	20.67		
	19/04/2005	40.67	72.00	40.67	32.00	26.00		
	02/05/2005	56.00	86.33	56.33	40.00	61.00		
	15/05/2005	86.33	85.33	91.33	43.33	88.67		
	28/05/2005	121.67	105.00	118.33	67.33	94.67		
	10/06/2005	103.00	124.33	95.00	66.00	88.33		
	Total	**458.33**	**541.00**	**433.00**	**304.00**	**406.67**		
	Mean	**65.48**	**77.29**	**61.86**	**43.43**	**58.10**		
Summer	23/06/2005	79.67	132.67	72.67	37.33	90.67	11.99	17.05
	06/07/2005	60.33	79.33	77.33	37.67	66.00		
	19/07/2005	36.70	124.70	49.30	67.33	41.00		
	01/08/2005	105.67	100.33	113.00	66.00	76.33		
	14/08/2005	127.33	72.33	106.33	87.00	66.33		
	27/08/2005	86.00	51.67	77.67	79.00	78.33		
	09/09/2005	90.00	114.33	109.67	70.00	140.67		
	22/09/2005	99.67	95.67	110.67	50.00	78.67		
	Total	**685.37**	**771.03**	**716.63**	**494.33**	**638.00**		
	Mean	**85.67**	**96.38**	**89.58**	**61.79**	**79.75**		
Total year		**1555.70**	**1726.70**	**1610.63**	**1056.33**	**1396.33**	**6.18**	**8.79**

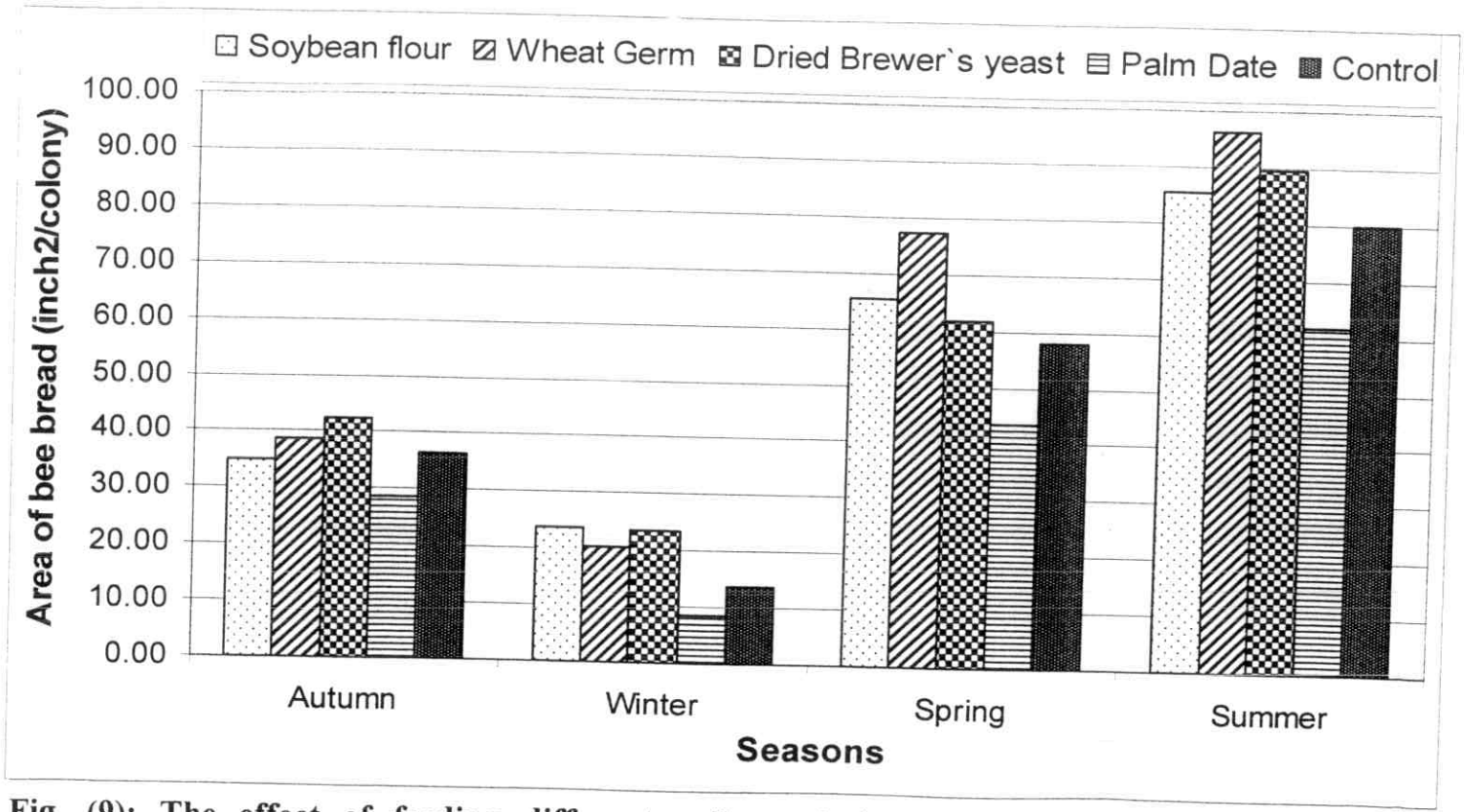

Fig. (9): The effect of feeding different pollen substitutes on the area of stored pollen (inch²/colony) in honey bee colonies during four seasons (2004-2005).

there were highly significant differences between Dried Brewer's yeast and each of Soybean flour, Control and Palm Date.

- **Winter:**

The mean of stored pollen area during winter season were 23.86, 20.62, 23.33, 8.38 and 13.76 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences among Soybean flour, Dried Brewer's yeast and Wheat Germ, while there were highly significant differences between Soybean flour and both of Control and Palm Date.

- **Spring:**

The mean of stored pollen area during spring season were 65.48, 77.29, 61.86, 43.43 and 58.1 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Soybean flour, while there were significant differences between Wheat Germ and Dried Brewer's yeast. There were highly significant differences between Wheat Germ and both of Control and Palm Date.

- **Summer:**

The mean of stored pollen area during summer season were 85.67, 96.38, 89.58, 61.79 and 79.75 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences among Wheat Germ, Dried Brewer's yeast and Soybean flour, but there were significant differences between Wheat Germ and both of Control and Palm Date.

The data tabulated in table (5) showed that the total of stored pollen area measured from each treatment of (Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control) during the second year were 1555.7, 1726.7, 1610.63, 1056.33 and 1396.33 inch²/colony, respectively.

Statistical analysis of the data recorded in table (5) indicated that there were insignificant differences among Wheat Germ, Dried Brewer's yeast and Soybean flour, but there were highly significant differences between Wheat Germ and both of Control and Palm Date.

The results in tables (4, 5) and figures (8, 9) showed that the highest amount of stored pollen in the summer season, this may be due to the abundance of pollen plant sources in the region and the favorable weather factors to gathering activity for bees. While the lowest amount of stored pollen in the winter season, this may be due to infrequency of pollen plant sources and the weather condition were not favorable, since the temperature is low and the day light is short.

Also these results indicated that (Wheat Germ) gave the highest amount of the stored pollen, while (Palm Date) gave the lowest amount during study period.

there were highly significant differences between Dried Brewer's yeast and each of Soybean flour, Control and Palm Date.

- **Winter:**

The mean of stored pollen area during winter season were 23.86, 20.62, 23.33, 8.38 and 13.76 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences among Soybean flour, Dried Brewer's yeast and Wheat Germ, while there were highly significant differences between Soybean flour and both of Control and Palm Date.

- **Spring:**

The mean of stored pollen area during spring season were 65.48, 77.29, 61.86, 43.43 and 58.1 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Soybean flour, while there were significant differences between Wheat Germ and Dried Brewer's yeast. There were highly significant differences between Wheat Germ and both of Control and Palm Date.

- **Summer:**

The mean of stored pollen area during summer season were 85.67, 96.38, 89.58, 61.79 and 79.75 inch²/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences among Wheat Germ, Dried Brewer's yeast and Soybean flour, but there were significant differences between Wheat Germ and both of Control and Palm Date.

The data tabulated in table (5) showed that the total of stored pollen area measured from each treatment of (Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control) during the second year were 1555.7, 1726.7, 1610.63, 1056.33 and 1396.33 inch²/colony, respectively.

Statistical analysis of the data recorded in table (5) indicated that there were insignificant differences among Wheat Germ, Dried Brewer's yeast and Soybean flour, but there were highly significant differences between Wheat Germ and both of Control and Palm Date.

The results in tables (4, 5) and figures (8, 9) showed that the highest amount of stored pollen in the summer season, this may be due to the abundance of pollen plant sources in the region and the favorable weather factors to gathering activity for bees. While the lowest amount of stored pollen in the winter season, this may be due to infrequency of pollen plant sources and the weather condition were not favorable, since the temperature is low and the day light is short.

Also these results indicated that (Wheat Germ) gave the highest amount of the stored pollen, while (Palm Date) gave the lowest amount during study period.

2.2. Effect of pollen substitutes feeding during different months on pollen gathering activity in honeybee colonies:-

The results recorded in table (6) and fig. (10) showed that the mean amount of stored pollen during the first year was increased gradually and reached the highest rates in the period from May (307.56 g/colony) to August (327.38 g/colony), then decreased gradually to reach the lowest rates in the period from December (69.87 g/colony) to February (68.36 g/colony). While the mean amount of stored pollen during the second year was increased gradually and reached the highest rates in the period from May (320.44 g/colony) to September (383.73 g/colony), then decreased gradually to reach the lowest rates in the period from December (64.40 g/colony) to February (73.33 g/colony).

The above results are supported by **Todd and Reed (1970)** who found that the yield of pollen was closely correlated with the amount of brood. **El-Sherif *et al.* (1994)** showed that the ample pollen period extended from mid-March to mid-September (about 6 months). pollen dearth, (from September to December) monthly harvested pollen as well as drone and worker production gradually decreased and began to increase from January till the beginning of the ample pollen period in mid-March. **Eckert *et al.* (1994)** found that individual pollen foragers from colonies with higher brood quantities should exhibit a greater work effort for pollen resources than individual pollen foragers from colonies with low brood quantities. **Fathy (1998)** showed that the amounts of stored pollen in strong colonies were higher for all seasons than in weak colonies.

Table (6): Effect of feeding pollen substitutes during different months on pollen storage activity in two years of study in (g/colony).

years	Months	Treatments					Total	Mean
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control		
First year	January	59.33	60.67	68.67	38.00	34.67	**261.33**	**52.27**
	February	68.00	90.67	76.89	59.56	46.67	**341.78**	**68.36**
	March	116.67	106.67	94.00	98.67	90.67	**506.67**	**101.33**
	April	139.33	189.33	136.00	137.33	107.33	**709.33**	**141.87**
	May	329.78	390.67	311.11	235.56	270.67	**1537.78**	**307.56**
	June	321.33	303.33	398.67	178.67	249.33	**1451.33**	**290.27**
	July	240.00	351.33	293.33	210.67	268.67	**1364.00**	**272.80**
	August	326.67	382.22	371.11	288.44	268.44	**1636.89**	**327.38**
	September	216.67	176.67	241.33	136.00	238.67	**1009.33**	**201.87**
	October	113.33	102.00	121.33	121.33	95.33	**553.33**	**110.67**
	November	105.33	118.67	114.67	94.67	105.78	**539.11**	**107.82**
	December	92.00	86.00	73.33	40.67	57.33	**349.33**	**69.87**
Second year	January	92.00	74.22	118.67	37.78	50.67	**373.33**	**74.67**
	February	106.67	93.33	83.33	18.67	64.67	**366.67**	**73.33**
	March	114.67	125.33	91.33	73.33	70.67	**475.33**	**95.07**
	April	124.67	199.33	105.33	122.00	93.33	**644.67**	**128.93**
	May	352.00	368.89	354.67	200.89	325.78	**1602.22**	**320.44**
	June	365.33	514.00	335.33	206.67	358.00	**1779.33**	**355.87**
	July	194.07	408.07	253.27	210.00	214.00	**1279.40**	**255.88**
	August	425.33	299.11	396.00	309.33	294.67	**1724.44**	**344.89**
	September	379.33	420.00	440.67	240.00	438.67	**1918.67**	**383.73**
	October	156.00	146.67	168.67	86.67	108.67	**666.67**	**133.33**
	November	128.89	190.67	186.67	144.00	155.11	**805.33**	**161.07**
	December	64.00	81.33	51.33	42.00	83.33	**322.00**	**64.40**

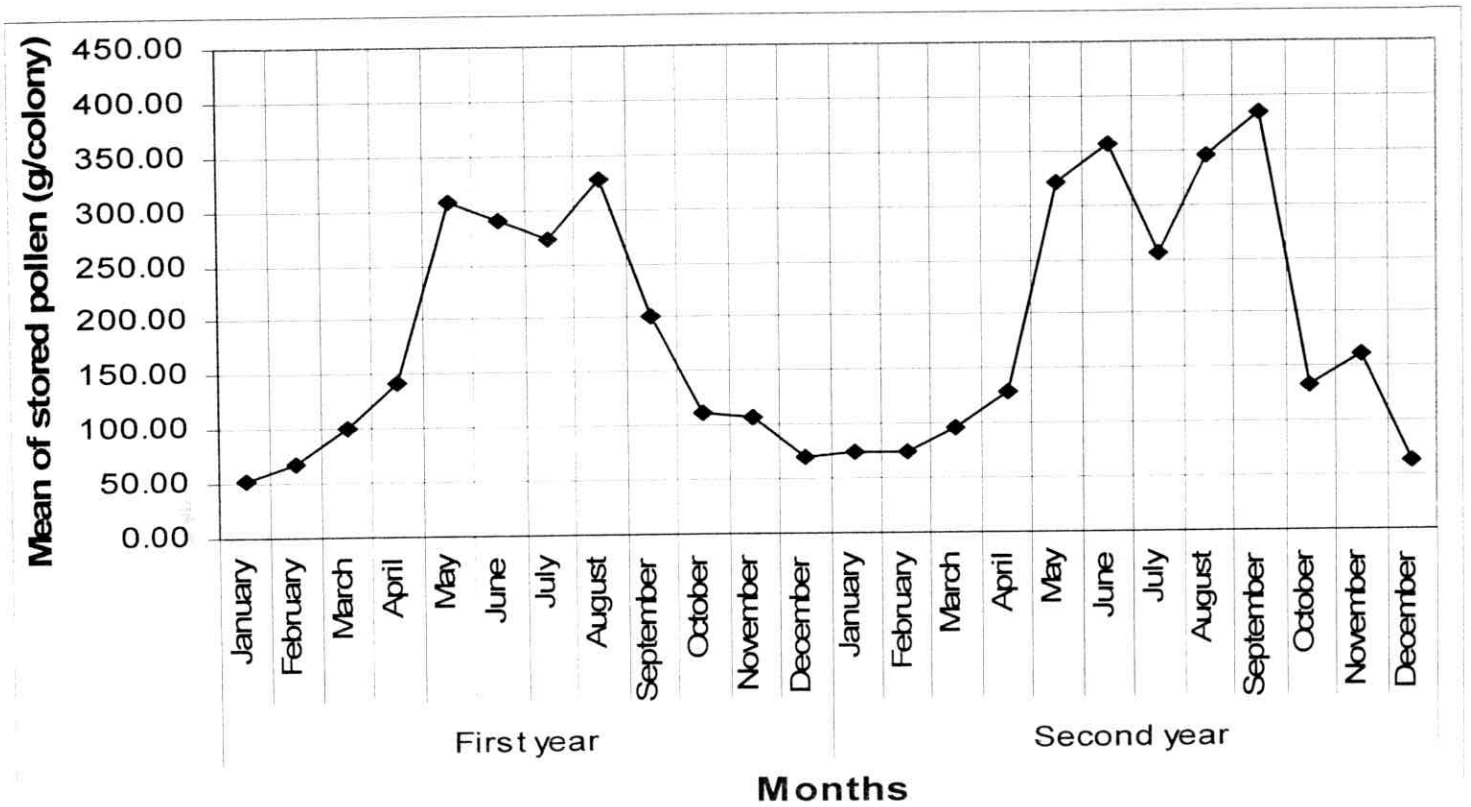

Fig. (10): The effect of pollen substitutes during different months on pollen storage activity in two years of study in (g/colony).

3. Queen cups building:

3.1. Effect of pollen substitutes feeding during different seasons on queen cups building in honeybee colonies:-

3.1.1. First year (2003-2004):

The data recorded in table (7) and fig. (11) during the four seasons showed the following:

- **Autumn:**

The mean numbers of queen cups during autumn season were 033, 0.38, 0.29, 0.24 and 0.19 cup /colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between the treatments.

- **Winter:**

The mean numbers of queen cups during winter season were 0.57, 0.62, 0.81, 0.24 and 0.29 cup /colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between Dried Brewer's yeast and Wheat Germ, but there were significant differences between Dried Brewer's yeast and each of Soybean flour, Control and Palm Date.

- **Spring:**

The mean numbers of queen cups during spring season were 3.29, 5.14, 4.33, 2.67 and 2.43 cup /colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Table (7): The effect of feeding different pollen substitutes on honeybee activety of puilding queen cups during four season (2003-2004).

Season	Date	Treatments					L.S.D.	
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control	0.05	0.01
Autumn	25/09/2003	0.00	0.33	0.33	0.33	0.00	--	--
	08/10/2003	0.33	0.67	0.33	0.33	0.00		
	21/10/2003	0.33	0.67	0.00	0.33	0.33		
	03/11/2003	1.00	0.00	0.00	0.33	0.33		
	16/11/2003	0.67	0.67	0.33	0.00	0.67		
	29/11/2003	0.00	0.33	0.33	0.33	0.00		
	12/12/2003	0.00	0.00	0.67	0.00	0.00		
	Total	**2.33**	**2.67**	**2.00**	**1.67**	**1.33**		
	Mean	**0.33**	**0.38**	**0.29**	**0.24**	**0.19**		
Winter	25/12/2003	0.00	0.00	0.00	0.00	0.00	0.23	0.33
	07/01/2004	0.00	0.00	0.00	0.00	0.00		
	20/01/2004	0.00	0.00	0.00	0.00	0.00		
	02/02/2004	0.33	0.33	0.00	0.00	0.33		
	15/02/2004	1.33	0.00	0.00	0.00	0.00		
	28/02/2004	0.00	0.67	2.33	0.67	0.67		
	12/03/2004	2.33	3.33	3.33	1.00	1.00		
	Total	**4.00**	**4.33**	**5.67**	**1.67**	**2.00**		
	Mean	**0.57**	**0.62**	**0.81**	**0.24**	**0.29**		
Spring	25/03/2004	4.00	6.00	4.33	2.67	1.33	0.63	0.90
	07/04/2004	3.67	8.00	7.00	3.67	3.00		
	20/04/2004	4.00	9.67	6.00	2.67	4.00		
	03/05/2004	3.67	4.67	3.00	2.33	3.33		
	16/05/2004	3.00	4.33	4.67	2.67	2.67		
	29/05/2004	2.00	2.00	4.00	3.00	1.67		
	11/06/2004	2.67	1.33	1.33	1.67	1.00		
	Total	**23.00**	**36.00**	**30.33**	**18.67**	**17.00**		
	Mean	**3.29**	**5.14**	**4.33**	**2.67**	**2.43**		
Summer	24/06/2004	2.67	4.33	4.33	2.00	3.33	0.45	0.65
	07/07/2004	1.67	2.67	4.00	1.00	3.67		
	20/07/2004	3.33	3.00	4.67	1.33	1.67		
	02/08/2004	2.67	2.67	3.33	3.67	1.33		
	15/08/2004	4.33	3.00	1.33	2.00	3.33		
	28/08/2004	2.00	2.33	1.33	0.67	2.00		
	10/09/2004	1.33	2.67	0.67	1.00	1.00		
	Total	**18.00**	**20.67**	**19.67**	**11.67**	**16.33**		
	Mean	**2.57**	**2.95**	**2.81**	**1.67**	**2.33**		
Total year		**47.33**	**63.67**	**57.67**	**33.67**	**36.67**	**0.18**	**0.26**

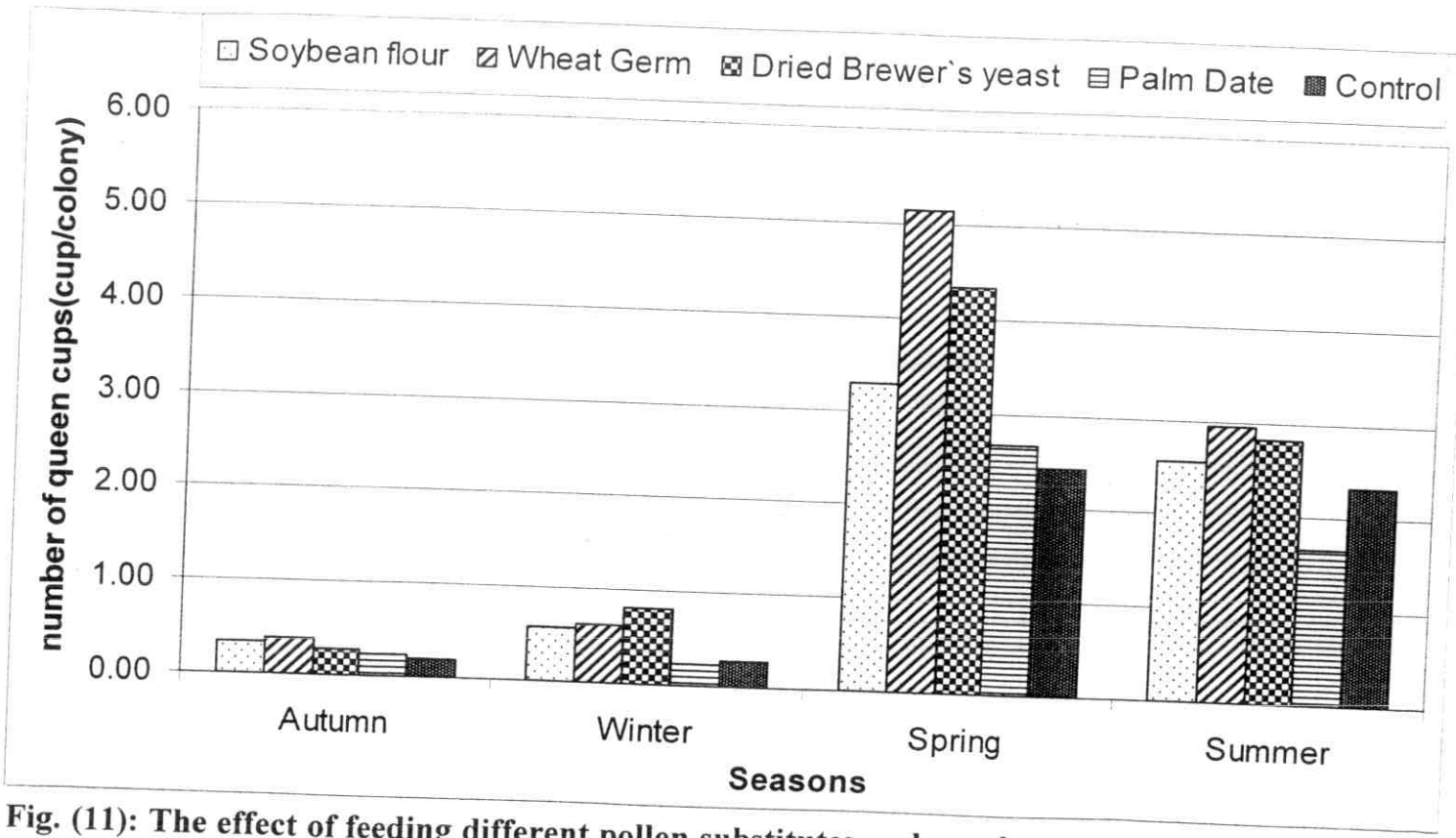

Fig. (11): The effect of feeding different pollen substitutes on honeybee activity of building queen cups during four seasons (2003-2004).

Statistical analysis indicated that there were significant differences between Wheat Germ and all other treatments (Dried Brewer's yeast, Soybean flour, Palm Date and Control), respectively.

- **Summer:**

The mean numbers of queen cups during summer season were 2.57, 2.95, 2.81, 1.67 and 2.33 cup /colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences among Wheat Germ, Dried Brewer's yeast and Soybean flour, while there were significant differences between Wheat Germ and both of Control and Palm Date.

The data tabulated in table (7) showed that the total of queen cups from each treatment of (Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control) during the first year were 47.33, 63.67, 57.67, 33.67 and 36.67 cup /colony, respectively.

Statistical analysis from the data recorded in table (7) indicated that there were significant differences between Wheat Germ and all other treatments (Dried Brewer's yeast, Soybean flour, Control and Palm Date).

3.1.2. Second year (2004-2005):

The data recorded in table (8) and fig. (12) during the four seasons showed the following:

- **Autumn:**

The mean numbers of queen cups during autumn season were 0.19, 0.29, 0.14, 0.14 and 0 cup /colony for Soybean flour, Wheat

Table (8): The effect of feeding different pollen substitutes on honeybee activety of puilding queen cups during four season (2004-2005).

Season	Date	Treatments					L.S.D.	
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control	0.05	0.01
Autumn	23/09/2004	1.00	1.00	0.00	0.00	0.00	--	--
	06/10/2004	0.33	1.00	0.33	0.00	0.00		
	19/10/2004	0.00	0.00	0.33	0.00	0.00		
	01/11/2004	0.00	0.00	0.33	0.00	0.00		
	14/11/2004	0.00	0.00	0.00	0.67	0.00		
	27/11/2004	0.00	0.00	0.00	0.33	0.00		
	10/12/2004	0.00	0.00	0.00	0.00	0.00		
	Total	**1.33**	**2.00**	**1.00**	**1.00**	**0.00**		
	Mean	**0.19**	**0.29**	**0.14**	**0.14**	**0.00**		
Winter	23/12/2004	0.00	0.00	0.00	0.00	0.00	0.32	0.45
	05/01/2005	0.00	0.00	0.00	0.00	0.00		
	18/01/2005	0.00	0.00	0.00	0.00	0.00		
	31/01/2005	0.33	0.33	0.33	0.00	0.00		
	13/02/2005	0.67	1.00	0.33	0.00	0.00		
	26/02/2005	0.00	0.67	0.33	0.00	0.33		
	11/03/2005	3.67	5.33	4.67	1.00	2.00		
	Total	**4.67**	**7.33**	**5.67**	**1.00**	**2.33**		
	Mean	**0.67**	**1.05**	**0.81**	**0.14**	**0.33**		
Spring	24/03/2005	3.00	4.33	3.67	1.67	0.67	1.54	2.20
	06/04/2005	4.67	8.00	5.33	2.00	4.67		
	19/04/2005	6.00	5.33	6.00	1.33	0.00		
	02/05/2005	3.67	8.33	8.33	2.67	3.67		
	15/05/2005	3.33	8.33	5.00	4.33	6.00		
	28/05/2005	4.00	4.00	7.00	3.00	2.67		
	10/06/2005	1.67	1.33	4.00	1.67	2.00		
	Total	**26.33**	**39.67**	**39.33**	**16.67**	**19.67**		
	Mean	**3.76**	**5.67**	**5.62**	**2.38**	**2.81**		
Summer	23/06/2005	2.00	4.00	4.33	1.33	3.33	0.44	0.63
	06/07/2005	1.67	3.67	3.00	0.33	1.00		
	19/07/2005	4.33	2.33	3.00	1.67	4.33		
	01/08/2005	3.33	1.67	1.00	2.33	3.00		
	14/08/2005	2.33	2.33	1.67	1.00	2.67		
	27/08/2005	1.00	3.33	3.67	1.00	1.33		
	09/09/2005	3.33	2.67	1.00	1.00	2.33		
	22/09/2005	4.33	3.33	1.33	1.00	1.33		
	Total	**22.33**	**23.33**	**19.00**	**9.67**	**19.33**		
	Mean	**2.79**	**2.92**	**2.38**	**1.21**	**2.42**		
Total year		**54.67**	**72.33**	**65.00**	**28.33**	**41.33**	**0.53**	**0.75**

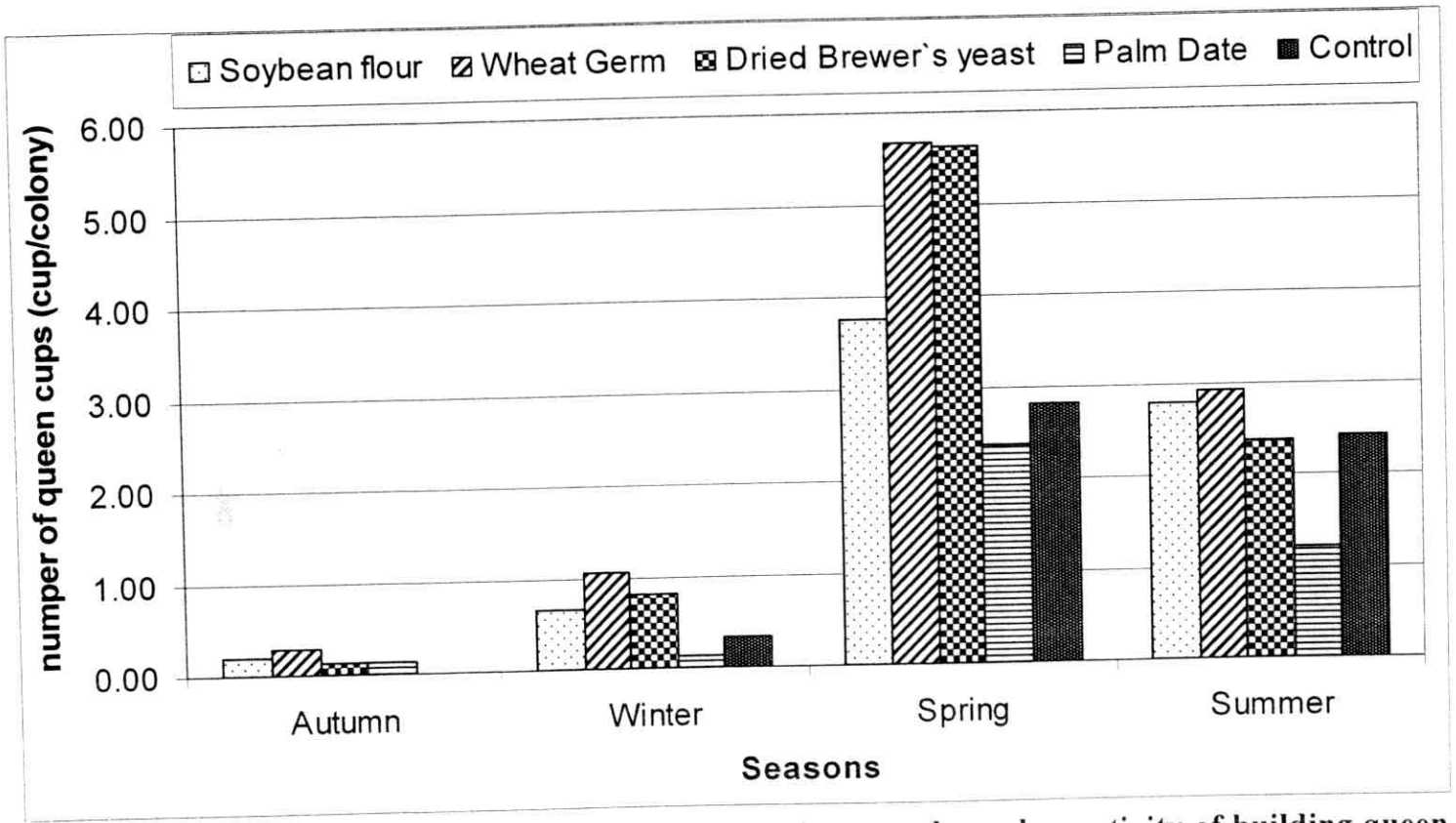

Fig. (12): The effect of feeding different pollen substitutes on honeybee activity of building queen cups during four seasons (2004-2005).

Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between the treatments.

- **Winter:**

The mean numbers of queen cups during winter season were 0.67, 1.05, 0.81, 0.14 and 0.33 cup /colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were significant differences between Wheat Germ and each of Soybean flour, Control and Palm Date.

- **Spring:**

The mean numbers of queen cups during spring season were 3.76, 5.67, 5.62, 2.38 and 2.81 cup /colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were significant differences between Wheat Germ and each of Soybean flour, Control and Palm Date.

- **Summer:**

The mean numbers of queen cups during summer season were 2.79, 2.92, 2.38, 1.21 and 2.42 cup /colony for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Soybean flour, while there were significant differences between Wheat Germ and each of Dried Brewer's yeast, Control and Palm Date.

The data tabulated in table (8) showed that the total of queen cups from each treatment of (Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control) during the second year were 54.67, 72.33, 65, 28.33 and 41.33 cup /colony, respectively.

Statistical analysis from the data recorded in table (8) indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were significant differences between Wheat Germ and each of Soybean flour, Control and Palm Date.

These results in tables (7, 8) and figures (11, 12) obtained that the highest number of queen cups building in the spring season, this may be due to increase in brood rearing, pollen storage and the colonies will be able to build up the nurse bees which are building the queen cups. While the lowest number of queen cups building in the autumn season, this may be due to decrease in honeybee activities as a result of fluctuations of the weather factors and shortage of nectar and pollen plant sources.

Also these results indicated that (Wheat Germ) gave the highest number of queen cups building, while (Palm Date) gave the lowest number during period study.

3.2. Effect of pollen substitutes feeding during different months on queen cups building in honeybee colonies:-

From the results recorded in table (9) and fig. (13) showed that the mean number of queen cups during the first year was

Table (9): Effect of feeding pollen substitutes during different months on queen cups building activity in two years of study.

years	Months	Treatments					Total	Mean
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	Control		
First year	January	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**
	February	0.56	0.33	0.78	0.22	0.33	**2.22**	**0.44**
	March	3.17	4.67	3.83	1.83	1.17	**14.67**	**2.93**
	April	3.83	8.83	6.50	3.17	3.50	**25.83**	**5.17**
	May	2.89	3.67	3.89	2.67	2.56	**15.67**	**3.13**
	June	2.67	2.83	2.83	1.83	2.17	**12.33**	**2.47**
	July	2.50	2.83	4.33	1.17	2.67	**13.50**	**2.70**
	August	3.00	2.67	2.00	2.11	2.22	**12.00**	**2.40**
	September	1.17	1.83	0.33	0.50	0.50	**4.33**	**0.87**
	October	0.33	0.67	0.17	0.33	0.17	**1.67**	**0.33**
	November	0.56	0.33	0.22	0.22	0.33	**1.67**	**0.33**
	December	0.00	0.00	0.33	0.00	0.00	**0.33**	**0.07**
Second year	January	0.11	0.11	0.11	0.00	0.00	**0.33**	**0.07**
	February	0.33	0.83	0.33	0.00	0.17	**1.67**	**0.33**
	March	3.33	4.83	4.17	1.33	1.33	**15.00**	**3.00**
	April	5.33	6.67	5.67	1.67	2.33	**21.67**	**4.33**
	May	3.67	6.89	6.78	3.33	4.11	**24.78**	**4.96**
	June	1.83	2.67	4.17	1.50	2.67	**12.83**	**2.57**
	July	3.00	3.00	3.00	1.00	2.67	**12.67**	**2.53**
	August	2.22	2.44	2.11	1.44	2.33	**10.56**	**2.11**
	September	3.83	3.00	1.17	1.00	1.83	**10.83**	**2.17**
	October	0.17	0.50	0.33	0.00	0.00	**1.00**	**0.20**
	November	0.00	0.00	0.11	0.33	0.00	**0.44**	**0.09**
	December	0.00	0.00	0.00	0.00	0.00	**0.00**	**0.00**

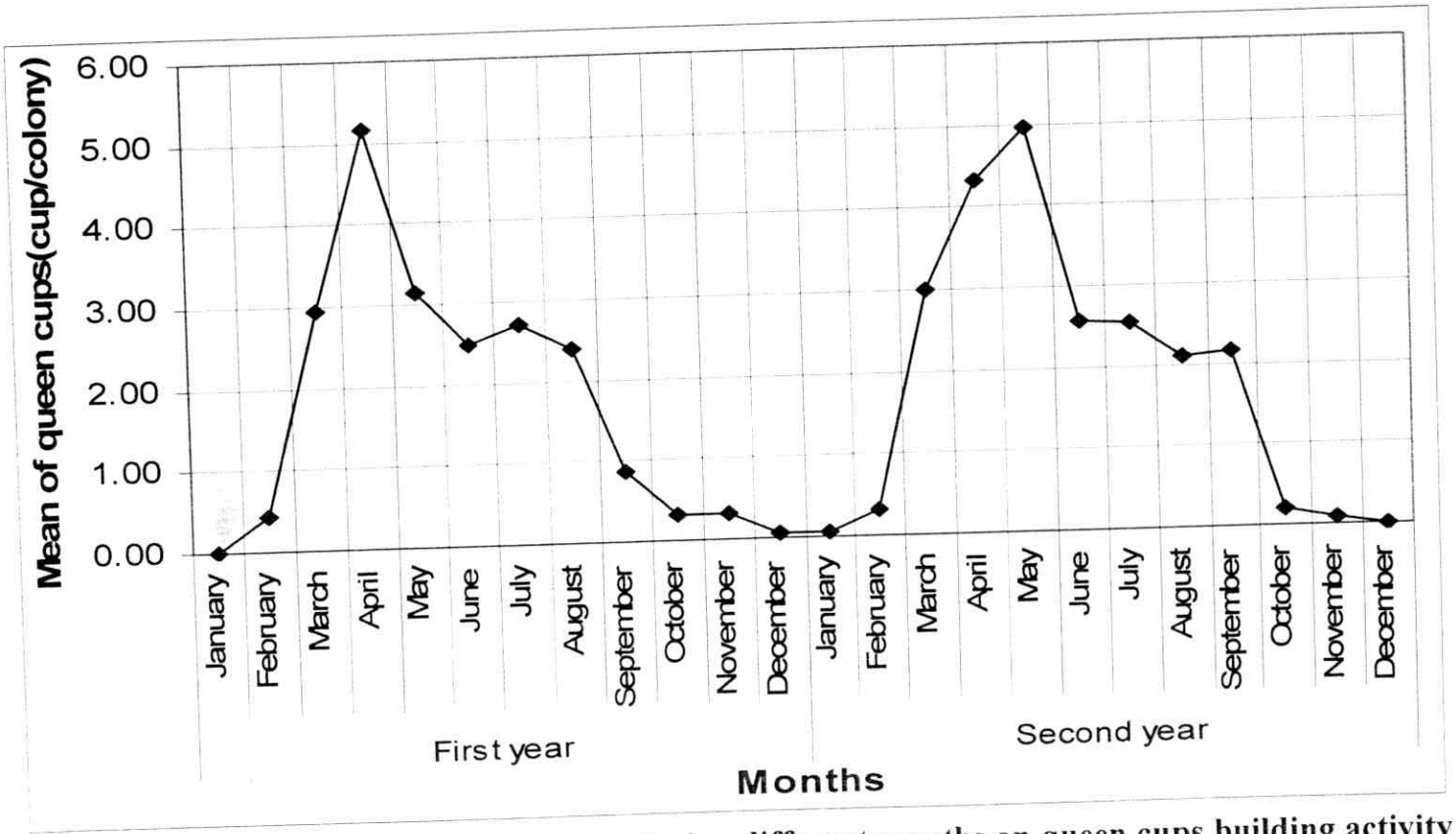

Fig. (13): The effect of pollen substitutes during different months on queen cups building activity in two years of study.

increased gradually and reached the highest rates in April (5.17 cups/colony) and May (3.13 cups/colony), then decreased gradually to reach the lowest rates in the period from October (0.33 cup/colony) to January (0.00 cup/colony). While the mean number of queen cups during the second year was increased gradually and reached the highest rates in April (4.33 cups/colony) and May (4.96 cups/colony), then decreased gradually to reach the lowest rates in the period from October (0.20 cup/colony) to January (0.07 cup/colony).

The above results are agreed with **Cobey (1992)** who observed that the populous enough were always to shake out bees for queen rearing cell builders by the first of March. The Carniolans traditionally maintain a tight brood nest. During the honey flow the brood nest can quickly become honey bound. This is especially important in the early spring during rapid population buildup. **Elshemy (1997)** showed that building the queen cups was higher in fed colonies than in unfed ones (Control). **El-Waseef (2002)** found that the fed colonies were active in building more queen cups than unfed ones and higher building queen cups in March. **Shoreit *et al.* (2002)** found that the maximum total of queen cups was found during February-April period or swarming period. Minimum construction of queen cups was observed during November and December.

4. Pollen substitutes consumption:

4.1. The consumption of pollen substitutes in honeybee colonies during different seasons:-

4.1.1. First year (2003-2004):

The data recorded in table (10) and fig. (14) during the four seasons showed the following:

- **Autumn:**

The mean amounts of pollen substitutes consumed by bees during autumn season were 93.23, 114.79, 125.34 and 75.14 g/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date, respectively.

Statistical analysis indicated that there were significant differences between Dried Brewer's yeast and all other treatments, but there were highly significant differences between Dried Brewer's yeast and both of Soybean flour and Palm Date.

- **Winter:**

The mean amounts of pollen substitutes consumed by bees during winter season were 111.5, 144.73, 146.19 and 75.89 g/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date, respectively.

Statistical analysis indicated that there were insignificant differences between Dried Brewer's yeast and Wheat Germ, while there were highly significant differences between Dried Brewer's yeast and both of Soybean flour and Palm Date.

- **Spring:**

The mean amounts of pollen substitutes consumed by bees during spring season were 200.54, 229.06, 224.84 and 165.84

Table (10): **Amounts of pollen substitutes (g/colony) consumed by honeybees during four seasons (2003-2004).**

Season	Date	Treatments				L.S.D.	
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	0.05	0.01
Autumn	08/10/2003	114.13	124.63	120.00	102.13	7.64	11.11
	21/10/2003	99.67	118.23	103.80	85.20		
	03/11/2003	110.87	131.33	115.97	97.07		
	16/11/2003	92.33	112.47	139.87	68.20		
	29/11/2003	75.30	92.93	146.97	40.47		
	12/12/2003	67.10	109.17	125.47	57.77		
	Total	**559.40**	**688.77**	**752.07**	**450.83**		
	Mean	**93.23**	**114.79**	**125.34**	**75.14**		
Winter	25/12/2003	58.53	128.07	133.37	43.57	6.79	9.88
	07/01/2004	95.20	117.67	126.00	49.20		
	20/01/2004	92.60	127.20	123.93	62.07		
	02/02/2004	116.87	146.23	141.03	77.40		
	15/02/2004	135.10	151.87	158.47	101.37		
	28/02/2004	118.87	166.80	172.10	80.17		
	12/03/2004	163.37	175.30	168.43	117.47		
	Total	**780.53**	**1013.13**	**1023.33**	**531.23**		
	Mean	**111.50**	**144.73**	**146.19**	**75.89**		
Spring	25/03/2004	168.33	192.37	178.60	121.00	9.75	14.18
	07/04/2004	142.77	209.33	189.67	138.63		
	20/04/2004	187.27	229.60	217.43	156.37		
	03/05/2004	213.57	230.40	249.37	131.17		
	16/05/2004	227.47	241.93	247.23	161.90		
	29/05/2004	235.73	249.80	247.97	214.20		
	11/06/2004	228.63	250.00	243.63	237.60		
	Total	**1403.77**	**1603.43**	**1573.90**	**1160.87**		
	Mean	**200.54**	**229.06**	**224.84**	**165.84**		
Summer	24/06/2004	233.07	243.97	237.83	183.83	9.51	13.84
	07/07/2004	227.27	226.10	195.77	240.47		
	20/07/2004	206.37	192.20	203.13	192.23		
	02/08/2004	158.87	175.00	167.20	130.70		
	15/08/2004	164.13	139.67	144.77	108.67		
	28/08/2004	133.97	120.67	127.33	86.83		
	10/09/2004	99.33	128.90	106.23	126.87		
	Total	**1223.00**	**1226.50**	**1182.27**	**1069.60**		
	Mean	**174.71**	**175.21**	**168.90**	**152.80**		
Total year		**3966.70**	**4531.83**	**4531.57**	**3212.53**	**5.36**	**7.80**

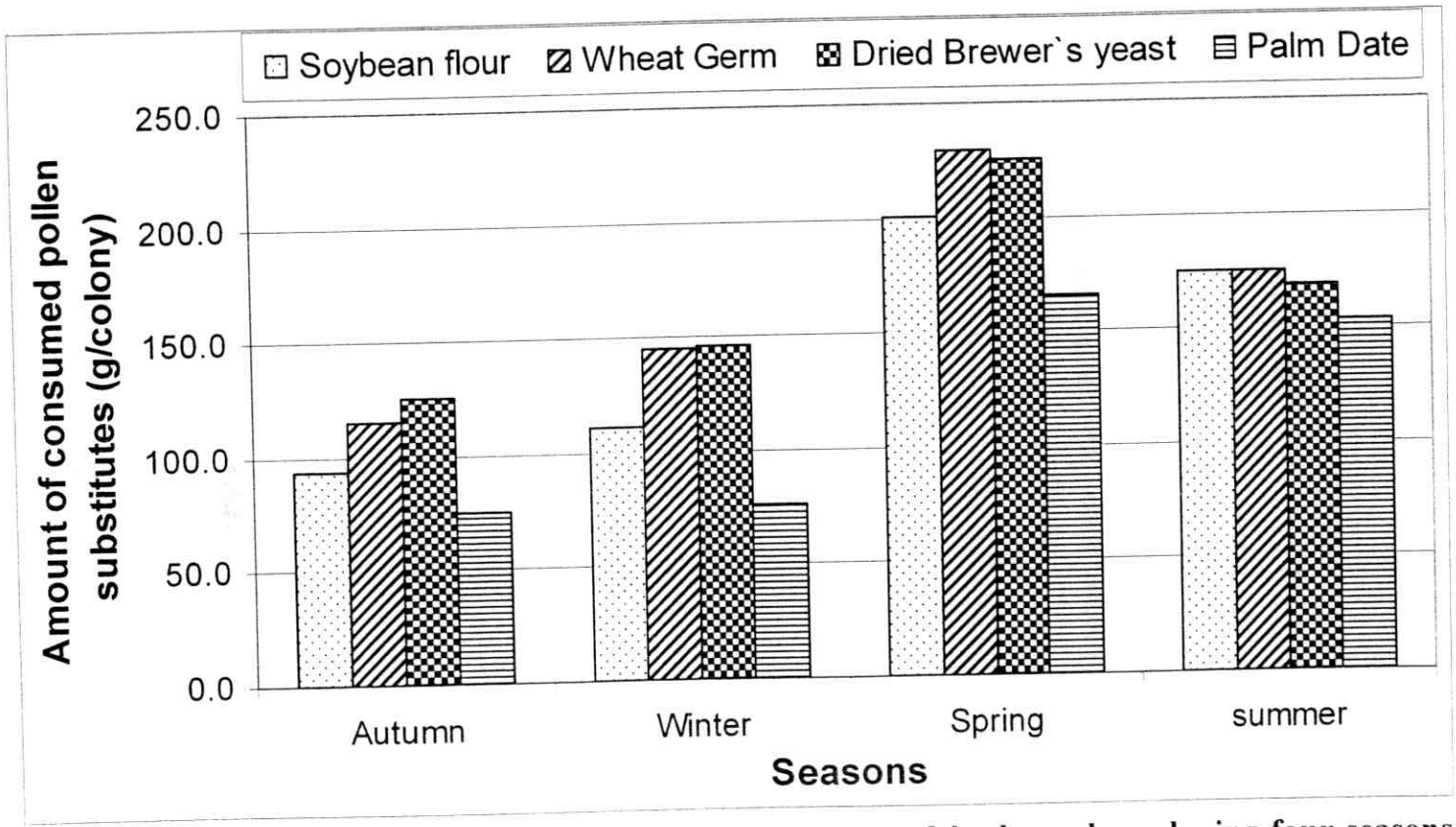

Fig. (14): Amounts of pollen substitutes (g/colony) consumed by honeybees during four seasons (2003-2004).

g/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were highly significant differences between Wheat Germ and both of Soybean flour and Palm Date.

- **Summer:**

The mean amounts of pollen substitutes consumed by bees during summer season were 174.71, 175.21, 168.9 and 152.8 g/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date, respectively.

Statistical analysis indicated that there were insignificant differences among Wheat Germ, Soybean flour and Dried Brewer's yeast, while there were highly significant differences between Wheat Germ and Palm Date.

The data tabulated in table (10) showed that the total amounts of pollen substitutes consumed by bees from each of (Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date) during the first year were 3966.7, 4531.83, 4531.57 and 3212.53 g/colony, respectively.

Statistical analysis from the data recorded in table (10) indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were highly significant differences between Wheat Germ and both of Soybean flour and Palm Date.

4.1.2. Second year (2004-2005):

The data recorded in table (11) and fig. (15) during the four seasons showed the following:

- **Autumn:**

The mean amounts of pollen substitutes consumed by bees during autumn season were 100.79, 118.51, 118.4 and 74.3 g/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were significant differences between Wheat Germ and both of Soybean flour and Palm Date.

- **Winter:**

The mean amounts of pollen substitutes consumed by bees during winter season were 125.06, 164.3, 165.02 and 84.97 g/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date, respectively.

Statistical analysis indicated that there were insignificant differences between Dried Brewer's yeast and Wheat Germ, while there were highly significant differences between Dried Brewer's yeast and both of Soybean flour and Palm Date.

- **Spring:**

The mean amounts of pollen substitutes consumed by bees during spring season were 197.02, 237.58, 233.73 and 188.8 g/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date, respectively.

Table (11): Amounts of pollen substitutes (g/colony) consumed by honeybees during four seasons (2004-2005).

Season	Date	Treatments				L.S.D.	
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date	0.05	0.01
Autumn	23/09/2004	128.60	107.07	64.33	97.00	12.62	18.37
	06/10/2004	115.33	137.90	105.67	60.60		
	19/10/2004	92.60	115.20	125.20	56.73		
	01/11/2004	83.53	96.30	127.73	94.23		
	14/11/2004	91.33	105.27	116.03	95.87		
	27/11/2004	78.67	139.53	149.10	62.13		
	10/12/2004	115.43	128.30	140.77	53.50		
	Total	**705.50**	**829.57**	**828.83**	**520.07**		
	Mean	**100.79**	**118.51**	**118.40**	**74.30**		
Winter	23/12/2004	91.50	136.77	147.20	67.63	12.41	18.06
	05/01/2005	122.40	166.97	166.90	77.13		
	18/01/2005	135.03	163.73	163.57	77.30		
	31/01/2005	126.90	157.67	158.87	98.77		
	13/02/2005	142.33	173.20	167.57	57.63		
	26/02/2005	120.90	174.37	172.70	109.97		
	11/03/2005	136.33	177.40	178.37	106.33		
	Total	**875.40**	**1150.10**	**1155.17**	**594.77**		
	Mean	**125.06**	**164.30**	**165.02**	**84.97**		
Spring	24/03/2005	176.20	197.50	192.80	131.63	7.29	10.61
	06/04/2005	190.07	223.53	217.70	173.07		
	19/04/2005	160.60	238.43	226.20	181.40		
	02/05/2005	199.80	240.07	239.70	196.70		
	15/05/2005	207.17	242.47	244.37	196.97		
	28/05/2005	217.70	254.70	252.77	215.30		
	10/06/2005	227.63	266.37	262.60	226.57		
	Total	**1379.17**	**1663.07**	**1636.13**	**1321.63**		
	Mean	**197.02**	**237.58**	**233.73**	**188.80**		
Summer	23/06/2005	257.83	244.77	245.90	221.43	11.32	16.47
	06/07/2005	205.77	212.93	210.73	179.20		
	19/07/2005	196.00	186.23	162.33	161.10		
	01/08/2005	147.83	194.43	190.57	134.03		
	14/08/2005	139.80	182.27	184.33	168.77		
	27/08/2005	123.57	189.77	166.63	150.80		
	09/09/2005	171.50	161.70	152.87	109.53		
	22/09/2005	169.07	162.37	162.30	124.23		
	Total	**1411.37**	**1534.47**	**1475.67**	**1249.10**		
	Mean	**176.42**	**191.81**	**184.46**	**156.14**		
Total year		**4371.43**	**5177.20**	**5095.80**	**3685.57**	**6.80**	**9.90**

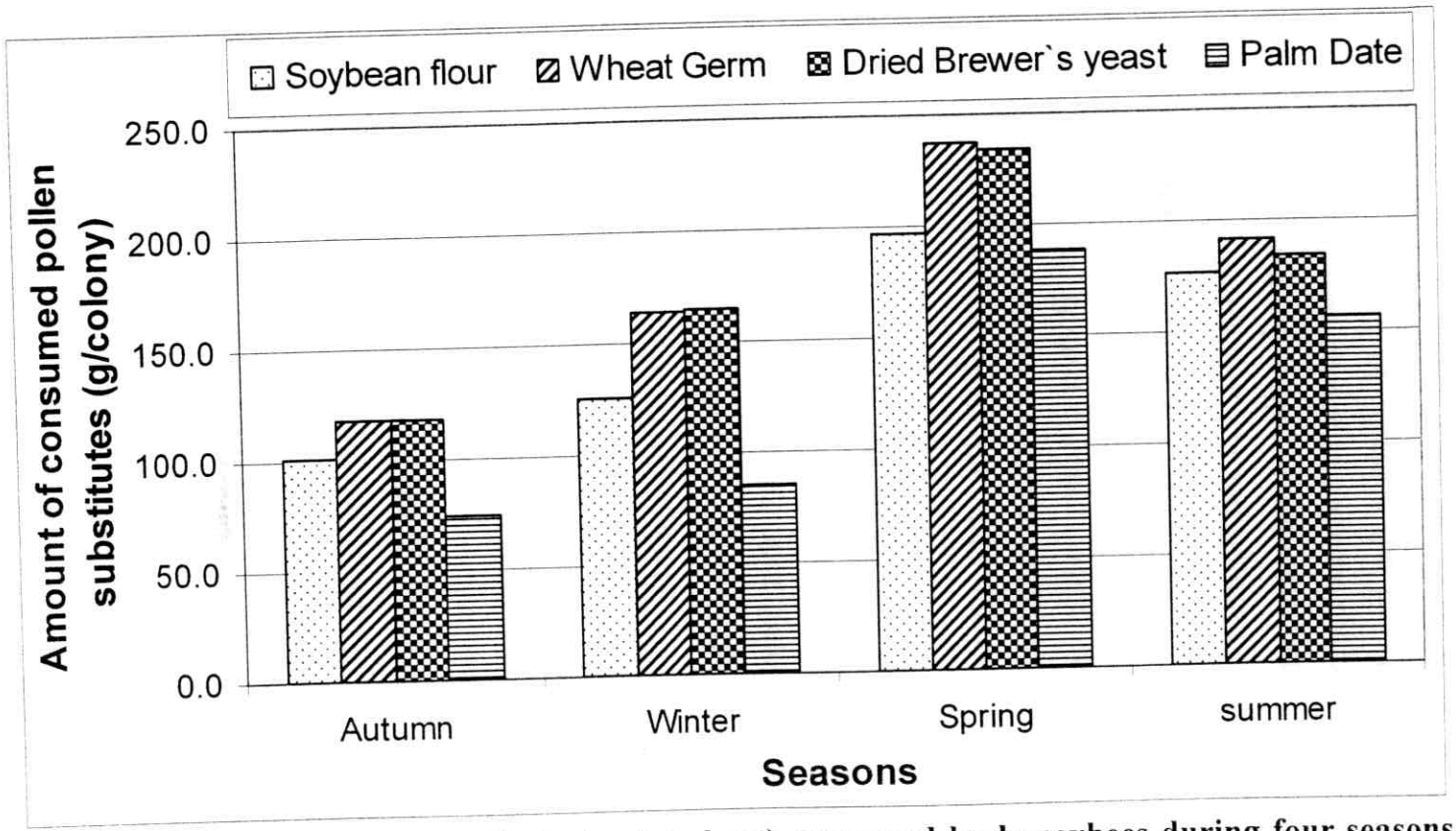

Fig. (15): Amounts of pollen substitutes (g/colony) consumed by honeybees during four seasons (2004-2005).

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were highly significant differences between Wheat Germ and both of Soybean flour and Palm Date.

- **Summer:**

The mean amounts of pollen substitutes consumed by bees during summer season were 176.42, 191.81, 184.46 and 156.14 g/colony for Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date, respectively.

Statistical analysis indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were significant differences between Wheat Germ and both of Soybean flour and Palm Date.

The data tabulated in table (11) showed that the total amounts of pollen substitutes consumed by bees from each of (Soybean flour, Wheat Germ, Dried Brewer's yeast and Palm Date) during the second year were 4371.43, 5177.2, 5095.8 and 3685.57 g/colony, respectively.

Statistical analysis from the data recorded in table (11) indicated that there were insignificant differences between Wheat Germ and Dried Brewer's yeast, while there were highly significant differences between Wheat Germ and both of Soybean flour and Palm Date.

The results in tables (10, 11) and figures (14, 15) cleared that the highest amount of pollen substitutes consumption in the spring season, this may be due to increase the population of bees in the hive as a result of increase the brood rearing activity. While the lowest amount of pollen substitutes consumption in the

autumn season, this may be due to decrease the brood rearing activity.

Also these results indicated that (Wheat Germ) gave the highest consumption rate, while (Palm Date) gave the lowest consumption rate during the second year.

4.2. The consumption of pollen substitutes in honeybee colonies during different months:-

The results recorded in table (12) and fig. (16) showed that the mean consumption of pollen substitutes during the first year was increased gradually and reached the highest rates in May (220.89 g/colony) and June (232.32 g/colony), then decreased gradually to reach the lowest rates in December (90.38 g/colony) and January (99.23 g/colony). While the mean consumption of pollen substitutes during the second year was increased gradually and reached the highest rates in May (225.64 g/colony) and June (244.14 g/colony), then decreased gradually to reach the lowest rates in the period from October (101.15 g/colony) to December (110.14 g/colony).

The above results are agreed with **Mohanny (1999)** who found that the consumption of pollen substitute (Wheat Germ) was higher than another diet during different seasons.

Table (12): The consumption of pollen substitutes during different months in two years of study.

years	Months	Treatments				Total	Mean
		Soybean flour	Wheat Germ	Dried Brewer`s yeast	Palm Date		
First year	January	93.90	122.43	124.97	55.63	**396.93**	**99.23**
	February	123.61	154.97	157.20	86.31	**522.09**	**130.52**
	March	165.85	183.83	173.52	119.23	**642.43**	**160.61**
	April	165.02	219.47	203.55	147.50	**735.53**	**183.88**
	May	225.59	240.71	248.19	169.09	**883.58**	**220.89**
	June	230.85	246.98	240.73	210.72	**929.28**	**232.32**
	July	216.82	209.15	199.45	216.35	**841.77**	**210.44**
	August	152.32	145.11	146.43	108.73	**552.60**	**138.15**
	September	113.97	117.98	85.28	111.93	**429.17**	**107.29**
	October	106.90	121.43	111.90	93.67	**433.90**	**108.48**
	November	92.83	112.24	134.27	68.58	**407.92**	**101.98**
	December	62.82	118.62	129.42	50.67	**361.52**	**90.38**
Second year	January	128.11	162.79	163.11	84.40	**538.41**	**134.60**
	February	131.62	173.78	170.13	83.80	**559.33**	**139.83**
	March	156.27	187.45	185.58	118.98	**648.28**	**162.07**
	April	175.33	230.98	221.95	177.23	**805.50**	**201.38**
	May	208.22	245.74	245.61	202.99	**902.57**	**225.64**
	June	242.73	255.57	254.25	224.00	**976.55**	**244.14**
	July	200.88	199.58	186.53	170.15	**757.15**	**189.29**
	August	137.07	188.82	180.51	151.20	**657.60**	**164.40**
	September	170.28	162.03	157.58	116.88	**606.78**	**151.70**
	October	103.97	126.55	115.43	58.67	**404.62**	**101.15**
	November	84.51	113.70	130.96	84.08	**413.24**	**103.31**
	December	103.47	132.53	143.98	60.57	**440.55**	**110.14**

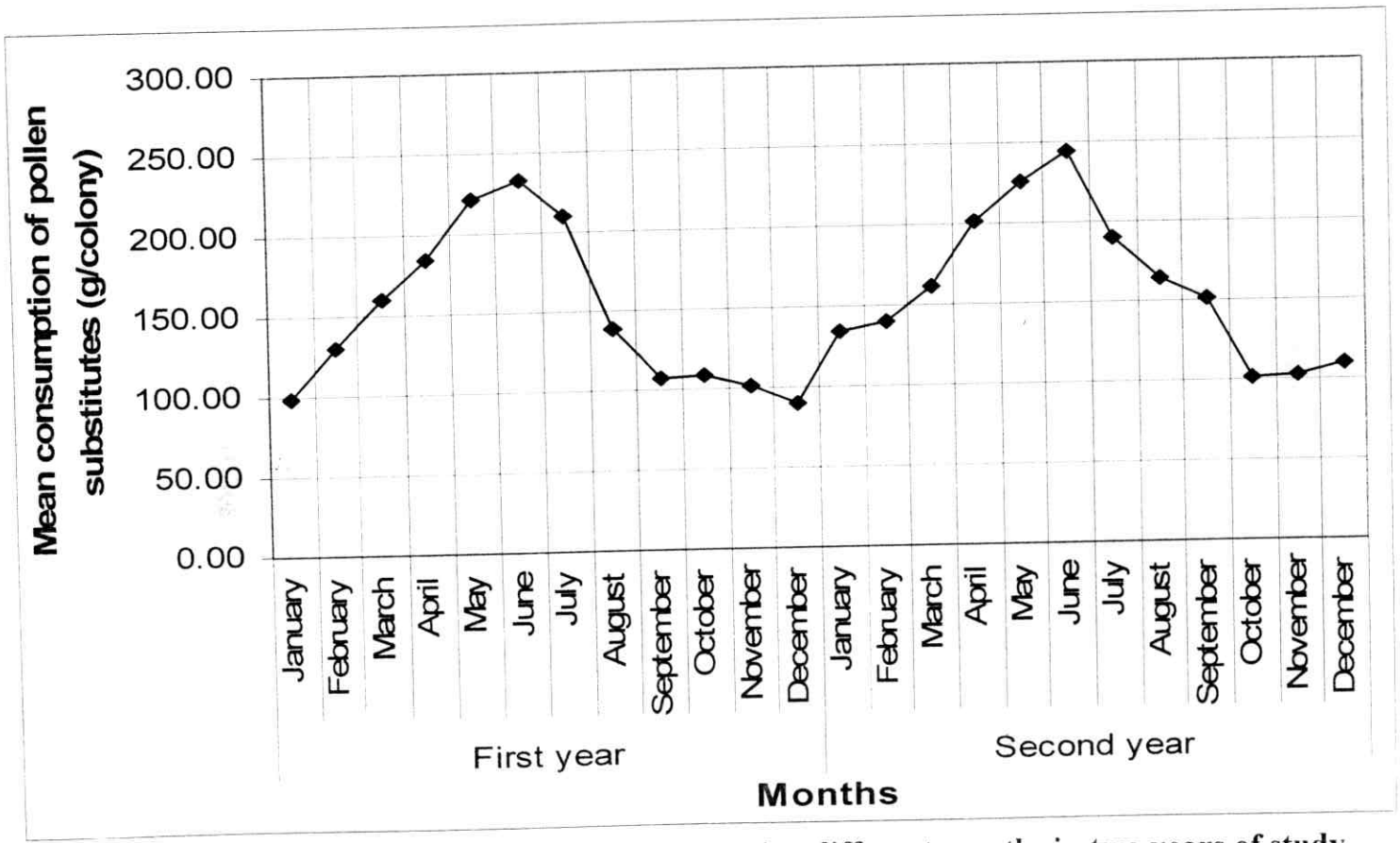

Fig. (16): The consumption of pollen substitutes during different months in two years of study.

5. Hypopharyngeal gland development:

The results tabulated in table (13) showed that the mean of the hypopharyngeal gland developmental stages during the experiment were 3.02, 2.95, 2.77, 2.13 and 2.1 with Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively. These results indicated that Soybean flour gave the highest development of the hypopharyngeal gland followed by Wheat Germ, Dried Brewer's yeast and Palm Date, respectively. While the Control gave the lowest development.

From the data recorded in table (13) and fig. (17) it was also found that the averages of the hypopharyngeal gland development stages in one day old workers were 2.6, 2.55, 2.5, 2.15 and 1.9 for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively. The averages of the hypopharyngeal gland development stages in three days old workers were 2.9, 2.95, 2.75, 2.35 and 2.25, respectively. The averages of the hypopharyngeal gland development stages in six days old workers were 3.55, 3.45, 3.25, 2.55 and 2.6, respectively. The averages of the hypopharyngeal gland development stages in nine days old workers were 3.35, 3.4, 2.95, 2.2 and 2.45, respectively. The averages of the hypopharyngeal gland development stages in twelve days old workers were 3.3, 3.15, 3.05, 1.95 and 2.05, respectively. The averages of the hypopharyngeal gland development stages in fifteen days old workers were 2.85, 2.75, 2.6, 2 and 1.9, respectively. The averages of the hypopharyngeal gland development stages in eighteen days old workers were 2.6, 2.4,

2.3, 1.7 and 1.55 with Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

From the results in table (13) and fig. (17) we found that the highest development of the hypopharyngeal gland in ages from six to twelve days.

Table (13): The effect of feeding different pollen substitutes on the development stages of the hepopharyngeal glands.

Treat. / Age	Soybean flour	Wheat Germ	Dried Brewer's yeast	Palm Date	Control	Total	Mean
1day	2.60	2.55	2.50	2.15	1.90	11.70	2.34
3days	2.90	2.95	2.75	2.35	2.25	13.20	2.64
6days	3.55	3.45	3.25	2.55	2.60	15.40	3.08
9days	3.35	3.40	2.95	2.20	2.45	14.35	2.87
12day	3.30	3.15	3.05	1.95	2.05	13.50	2.70
15day	2.85	2.75	2.60	2.00	1.90	12.10	2.42
18day	2.60	2.40	2.30	1.70	1.55	10.55	2.11
Total	**21.15**	**20.65**	**19.40**	**14.90**	**14.70**	**90.80**	**18.16**
Mean	**3.02**	**2.95**	**2.77**	**2.13**	**2.10**	**12.97**	--

L.S.D.for	Treat	Age
at 0.05	0.13	0.16
at 0.01	0.17	0.21

Statistical analysis from the data recorded in table (13) indicated that there were insignificant differences between Soybean flour and Wheat Germ, but there were highly significant differences between Soybean flour and each of Dried Brewer's yeast, Palm Date and Control. Whereas there were significant differences between different ages of bees.

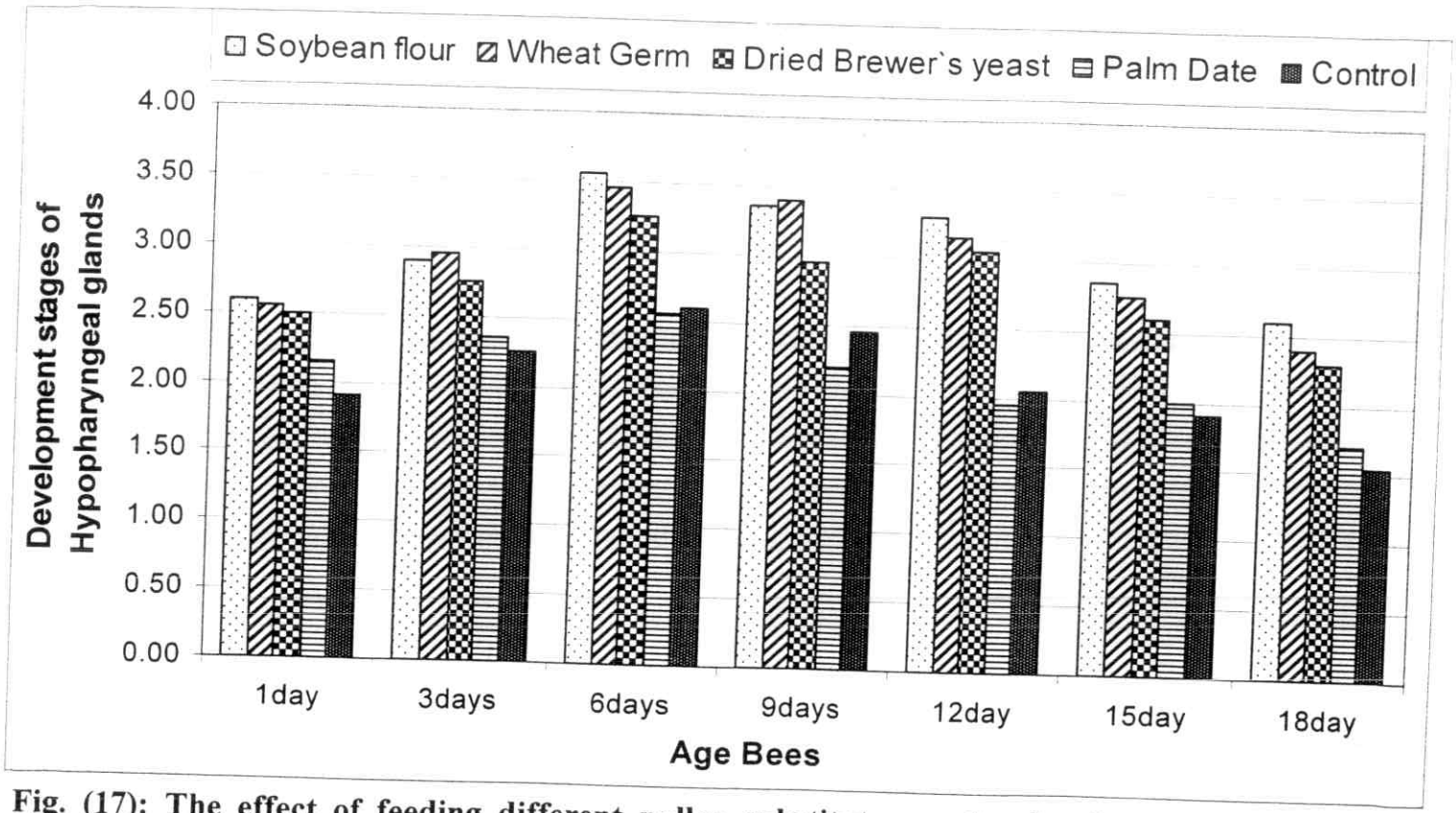

Fig. (17): The effect of feeding different pollen substitutes on the development stages of the hypopharyngeal glands.

The above results are agreed with **Darhous (1990)** who found that feeding caged bees on defatted soya flour, wheat bran, chick pea flour and date paste in their sole sources induced more development of the hypopharyngeal gland. **El-Dakhakhni and Metwally (1995)** showed that Hypopharyngeal gland more developed in workers of 10-days-old varied-on wheat bran than those fed on rice bran or mixture of wheat and rice brans. **Mohanny (1999)** found that the maximum development occurred was in the first group (the cake of wheat Germ and honey) and the lowest one was in the Control, while the second group (the cake of wheat Germ + pollen grains and honey) was in between.

6. Biometrical characters of wax mirror:

The results tabulated in table (14) showed that the mean of wax transversal measurements were 2.29, 2.29, 2.26, 2.29 and 2.29 mm for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively. The mean of wax longitudinal measurements were 1.31, 1.32, 1.28, 1.31 and 1.3 mm, respectively. The mean of distance between wax mirrors were 0.32, 0.3, 0.29, 0.32 and 0.32 mm, respectively.

The data recorded in table (14) and fig. (18) found that the maximum transversal of wax mirror (TW) from each treatment of Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control during the experiment were 2.34, 2.31, 2.28, 2.31 and 2.33 mm, respectively, while, the minimum transversal of wax mirror (TW) were 2.26, 2.27, 2.24, 2.24 and 2.26 mm, respectively.

Table (14): The effect of different pollen substitutes on the biometrical characters of wax mirror in different ages of honeybee workers.

Treat. / Age	Soybean flour			Wheat Germ			Dried Brewer's yeast			Palm Date			Control			Total			Mean		
	TW	LW	DW	TW	LW	DW	TW	LW	DW	TW	LW	DW	TW	LW	DW	TW	LW	DW	TW	LW	DW
12day	2.27	1.32	0.35	2.28	1.30	0.29	2.24	1.26	0.31	2.29	1.30	0.32	2.27	1.28	0.33	11.36	6.46	1.60	2.27	1.29	0.32
13day	2.34	1.32	0.28	2.29	1.31	0.33	2.27	1.26	0.30	2.24	1.32	0.31	2.26	1.28	0.33	11.40	6.49	1.54	2.28	1.30	0.31
14day	2.31	1.31	0.34	2.28	1.32	0.29	2.28	1.27	0.30	2.31	1.38	0.33	2.33	1.34	0.35	11.51	6.62	1.61	2.30	1.32	0.32
15day	2.28	1.33	0.33	2.27	1.35	0.29	2.25	1.29	0.26	2.28	1.29	0.35	2.29	1.30	0.36	11.37	6.57	1.59	2.27	1.31	0.32
16day	2.27	1.32	0.32	2.27	1.32	0.31	2.27	1.29	0.32	2.31	1.30	0.30	2.31	1.30	0.30	11.43	6.52	1.55	2.29	1.30	0.31
17day	2.29	1.29	0.32	2.29	1.32	0.30	2.24	1.29	0.27	2.28	1.29	0.32	2.32	1.31	0.30	11.43	6.51	1.51	2.29	1.30	0.30
18day	2.26	1.31	0.32	2.31	1.32	0.32	2.27	1.28	0.30	2.29	1.31	0.29	2.27	1.26	0.30	11.41	6.49	1.53	2.28	1.30	0.31
Total	**16.03**	**9.20**	**2.26**	**16.00**	**9.25**	**2.13**	**15.84**	**8.94**	**2.06**	**16.00**	**9.20**	**2.22**	**16.05**	**9.08**	**2.26**	**79.92**	**45.66**	**10.93**	**15.98**	**9.13**	**2.19**
Mean	**2.290**	**1.314**	**0.323**	**2.286**	**1.321**	**0.304**	**2.262**	**1.277**	**0.294**	**2.286**	**1.314**	**0.318**	**2.293**	**1.297**	**0.323**	**11.417**	**6.522**	**1.561**	**2.283**	**1.304**	**0.312**

TW =transversal of wax mirror. LW =longitudinal of wax mirror. DW = Distance between wax mirror.

	TW		LW		DW	
L.S.D. for	Tret.	Age	Tret.	Age	Tret.	Age
at 0.05=	n.s.	n.s.	0.0183	n.s.	0.0182	n.s.
at 0.01=			0.0244		0.0242	

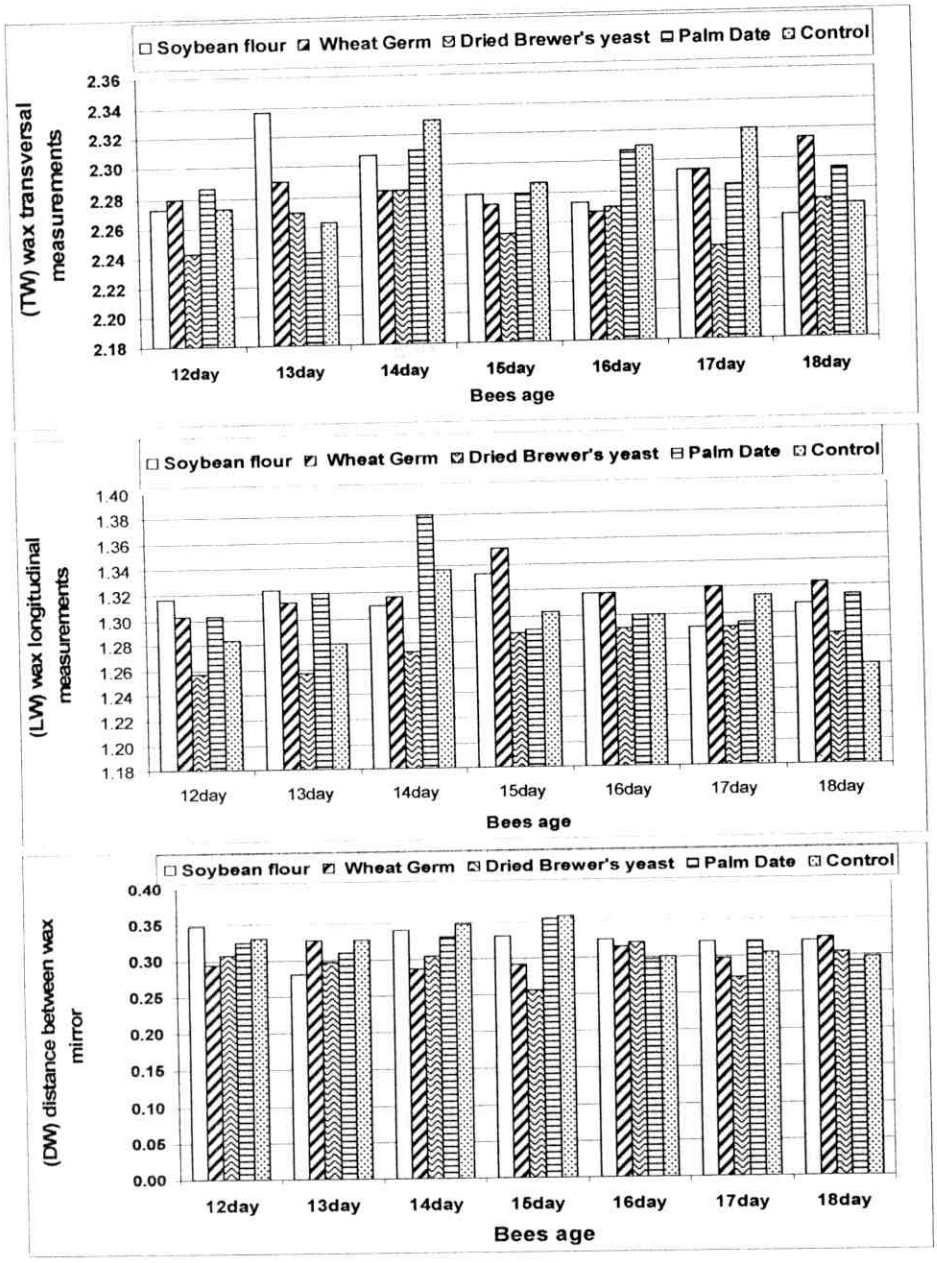

Fig.(18): The effect of different pollen substitutes on the biometrical characters of wax mirror in different ages of honeybee workers.

Also, data recorded in table (14) and fig. (18) indicate that the maximum longitudinal of wax mirror (LW) from each treatment of Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control during the experiment were 1.33, 1.35, 1.29 1.38 and 1.34 mm, respectively, while the minimum longitudinal of wax mirror (LW) were 1.29, 1.3, 1.26, 1.29 and 1.26 mm, respectively.

Also, data recorded in table (14) and fig. (18) indicate that the maximum distance between wax mirror (DW) from each treatment of Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control during the experiment were 0.35, 0.33, 0.32, 0.35 and 0.36 mm, respectively, while, the minimum distance between wax mirror (DW) were 0.28, 0.29, 0.26, 0.29 and 0.3 mm, respectively.

Statistical analysis from the data recorded in table (14) indicated that there were insignificant differences between the treatments in (TW), while there were highly significant differences between Soybean flour, Wheat Germ and Palm Date and both of Control and Dried Brewer's yeast in (LW), while there were significant differences between Soybean flour, Palm Date and Control and Wheat Germ, Dried Brewer's yeast in (DW). Whereas there were insignificant differences between different ages of bees.

The above results are agreed with **Hepburn (1988)** and **Hepburn and Magnuson (1988)** whose observed that there was a positive correlation between engorgement of the honey stomach and wax secretion. **Elbassiouny *et al.* (1999)** showed that the

adult bees were more active in transferring sugar syrup from feeders when building wax combs.

7. Longevity:

The results tabulated in table (15) and fig. (19) showed that the mean of longevity in newly emerged caged bees during the experiment were 15.07, 28.94, 23.01, 15.13 and 16.31 day /worker for Soybean flour, Wheat Germ, Dried Brewer's yeast, Palm Date and Control, respectively.

These results indicated that (Wheat Germ) gave the longest longevity followed by (Dried Brewer's yeast, Control and Palm Date), respectively, while (Soybean flour) gave the shortest longevity during the experiment.

Statistical analysis from the data recorded in table (15) indicated that there were highly significant differences between Wheat Germ and all other treatments, while there were insignificant differences between palm Date and Control.

The above results are agreed with **Werner (1987)** who showed that commercial pollen substitutes based on soybean flour are absolutely unsuitable. In particular, the loss of soybean products by foraging bees, lack of increase in the development of brood nest, high number of dead foraging bees. **Mansour (2002)** found that the diet C (200 g dried brewer's yeast + 200 g skim milk powder + 400 g soy bean flour + 350 g clover extract + 1 kg sugar powder = 2.150 kg.) gave good results in the first year for the life length, while diet A (200 g dried brewer's yeast + 300 g corn flour + 400 g chick pea flour + 100g bran + 1 kg sugar

powder + 0.5 L water = 2.500 kg.) was the best in the second year, generally these diets prolonged the life of caged bees than the Control bees.

Table (15): The effect of feeding different pollen substitutes on the longevity (day/worker) of caged bees taken from the tested colonies.

Treat. / Rep.	Soybean flour	Wheat Germ	Dried Brewer's yeast	Palm Date	Control
1	16.08	29.38	22.60	15.46	17.84
2	13.56	27.84	23.40	16.06	16.10
3	15.58	29.60	23.04	13.88	14.98
Total	45.22	86.82	69.04	45.40	48.92
Mean	15.07	28.94	23.01	15.13	16.31

L.S.D. at 0.05 = 2.02
at 0.01 = 2.88

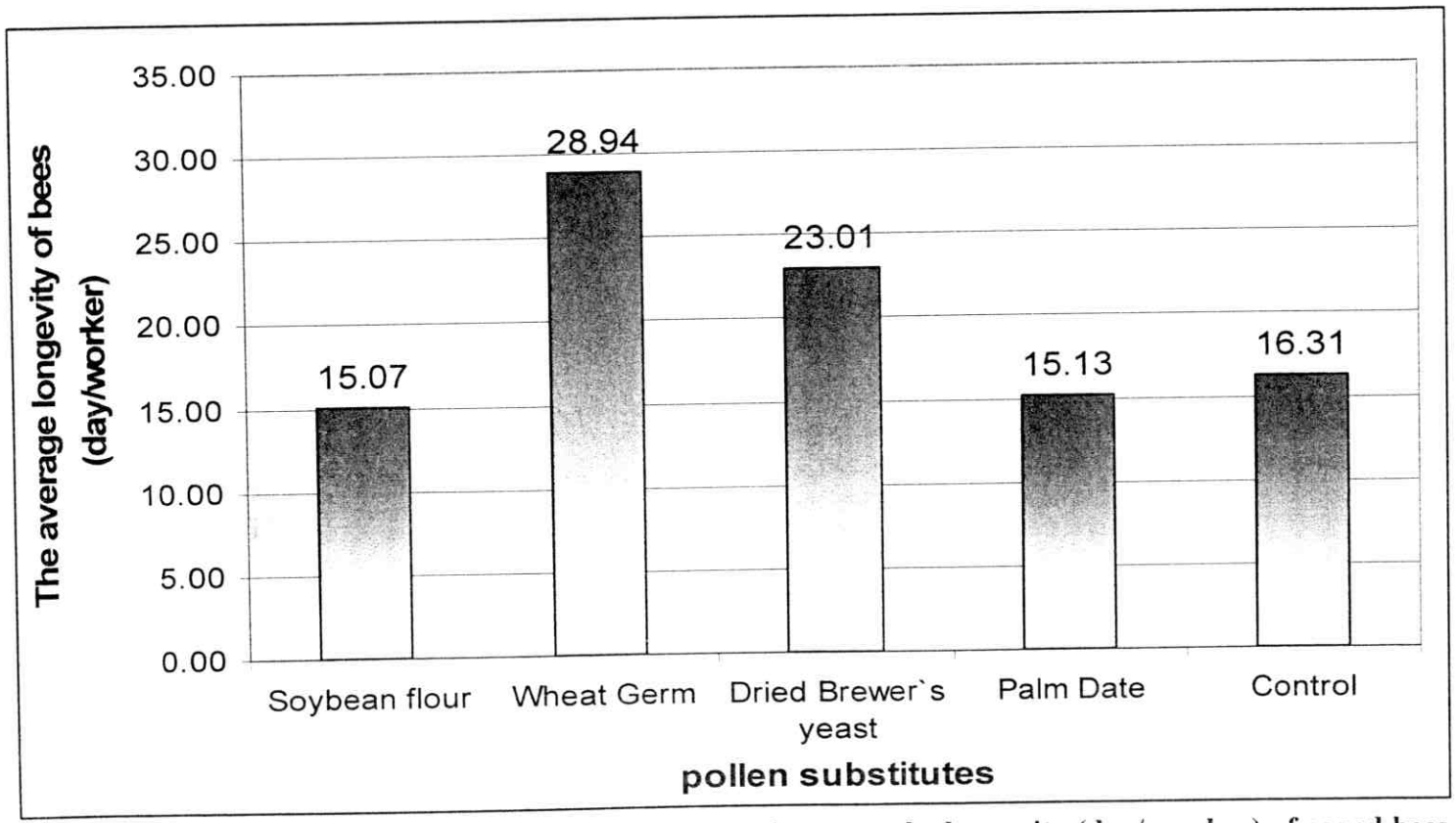

Fig. (19): The effect of feeding different pollen substitutes on the longevity (day/ worker) of caged bees taken from the tested colonies.