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Article

Using Some Available Palm Residues in New Valley as Alternative Bedding Materials for Raising Broilers

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Abstract

This study was conducted to evaluate the effect of some available plant residues as alternative litter materials in New Valley on growth performance, carcass traits, health status and economic efficiency of broiler. A total number of 180 one day old chicks of Cobb broiler were used. The study included six groups of treatments, with three replicates for each treatment (10 chicks per each); (wheat straw, wood sawdust, rice hulls, corn stalks chips, chopped palm fiber and palm spines chips litters). Results of growth performance (body weight, body weight gain, feed consumption and feed conversion) at market age, showed significant differences (P≤0.05) among studied litter types. Broiler reared on wheat straw, corn stalks chips and palm spines chips litters had significant superiority of body weight and gain over the broiler reared on wood sawdust, rice hulls and chopped palm fiber. Also, feed conversion of broiler reared on wheat straw, wood sawdust, corn stalks chips and palm spines chips litters had significant superiority values over the broiler reared on rice hulls and chopped palm fiber litters. No significant differences were found in dressed carcass, while, the lowest abdominal fat is observed for broilers raised on wood sawdust, corn stalks chips and chopped palm fiber litters. Broilers raised on wheat straw and wood sawdust had a significantly (P≤0.05) higher bursa percentage than those of birds raised on rice hulls and chopped palm fiber litters. The keel bone length for birds raised on wood sawdust, corn stalks chips and palm spines chips litters had significantly (P≤0.05) higher value as compared to those raised on chopped palm fiber litter. The lowest leg problems score is observed for broilers raised on corn stalks chips litter in comparison with those raised on rice hulls and chopped palm fiber litters. Depends on the economic efficiency and availability palm spines chips can be used as litter material instead of wood sawdust and wheat straw. In conclusion, corn stalks chips and palm spines chips can potentially be used as alternative litter materials for managing broilers in New Valley.

Keywords: Litter, growth performance, carcass traits, health status, broiler

1. Introduction

It is well known that poultry industry is one of the most dynamic of world's agribusiness trade. Furthermore, broiler production is generally acceptable to people all over the world and provides an excellent source of protein. Moreover, many of researchers showed that broiler growth is significantly influenced by environmental and managerial conditions. In broiler management, litter type has important influence broiler on performance, where good litter conditions lead to obtain optimum results of final productive traits and profits (**Farghly *et al.*, 2020**).

Litter is a mixture of excreta, spilled feed, spontaneously fallen feathers and farm bedding material (**Seidavi *et al.*, 2015**). Good litter should be characterised by light weight, medium-sized, good absorption property, fast drought, soft and easy to compress, low heat conductivity, low price and possess high efficiency of moisture absorption with a reasonable drying time (**Munir *et al.*, (2019; Farghly *et al.*, 2021**). Poor litter quality is considered a welfare problem in modern poultry production (**Bilgili *et al.*, 2009**). Litter serves several functions that include thermal insulation, moisture absorption and protective barrier from the ground. Moreover, it permits birds natural scratching behavior (**Škrbić *et al.*, 2012)**. Litter quality may play an important role in leg and skin health conditions, encouraging normal behaviours and broiler welfare (**Farghly 2017**; **Amer, 2020**).

In Egypt, most commonly used type of litter materials in broiler farms are wheat straw and wood sawdust. As a result of the limited availability, low supplies and expense of wheat straw and wood sawdust, many broiler producers are searching for alternative bedding materials (**Kuleile *et al.*, 2019; Monckton, *et al.*, 2020**). In New Valley, the use of other crop and palm residues has shown good potential as alternative bedding materials especially chopped palm fiber and palm spines chips litters for managing broilers due to their availability with cheap prices. There is little information on growth performance of broiler reared on chopped palm fiber and palm spines chips as litter materials. For that reason, the objective of this study was to evaluate the effect of some palm residues as litter materials on the performance of broilers under the prevailing environmental conditions in New Valley.

2. Materials and Methods

The experiment was carried out at the broiler farm (د /1/092/108) in Nasser city, El-Kharga, New Valley governorate, Egypt. The experiment was planned to evaluate the effect of the some available plant residues as alternative litter materials in New Valley on the growth performance, carcass traits, health status and economic efficiency of broiler. A total number of 180 one day old chicks of Cobb broiler were used. The study included six groups of treatments, with three replicates for each treatment (10 chicks per each); (wheat straw, wood sawdust, rice hulls, corn stalks chips, chopped palm fiber and palm spines chips litters). Each replicate was kept in a partition of 1 meter square provided with deep litter (8 -10 cm). The chicks were maintained under continuous lighting and vaccinated against New castle disease. The chicks were maintained under continuous lighting. The feed and fresh water were provided *ad libtum* and management condition was similar for all treatments throughout the experimental period. The birds fed commercial diets: starter diet from 0-2 wks of age (23% crude protein and 3000 Kcal. ME /kg of diet); grower diet from 3-4 wks of age (21% crude protein and 3100 Kcal. ME /kg of diet); finisher diet from 5-6 wks of age (19% crude protein and 3200 Kcal. ME /kg of diet). The chicks were reared under 32-33°C temperature at one-day of age and then gradually reduced to reach 23°C at the fourth week of age and thereafter.

The average of body weights (BW) at 0, 1, 2, 3, 4, 5 and 6 weeks of age were recorded and body weight gain (BWG) was calculated weekly. The weekly averages of feed consumption (FC) and

feed conversion values (g feed/g gain; FCR) were calculated weekly from 0 to 6 wks of age. At 6 weeks of age, 2 broilers/ pen for a total of 6 chickens/ treatment were chosen randomly and fasted for 8 hours before slaughtering. The edible organs (spleen, bursa, thymus glands, empty gizzard and spleen) as well as the abdominal fat were removed, weighed and calculated as percentages of carcass weight. The dressing percentage was calculated by dividing the carcass and giblets weights by the pre-slaughter live body weight of birds. At 6 weeks of age, birds per replicate were examined and scored (on a scale of 1 to 5) for leg problems, breast blisters and body measurements. The economical efficiency based on the average costs of feed consumed and litter quantities used as well as the average income/bird were calculated. The net revenue per bird was estimated as the difference between the total sale price (LE), and the costs (LE) of feeds consumed and litter used, according to the prevailing prices in the local Egyptian market during the experimental period during the experiment.

Statistical Analysis

Data collected were subjected to analysis of variance by applying the General Linear Models Procedure of SAS software (SAS Institute, version 9.2, 2009). Duncan (1955) was used to detect differences among means of different groups. The percentages of carcass and organs were transformed to Arcsin values then re-transformed to the original values after analysis. The following model was adopted for analysis of variance:

$$Xij = \mu + \alpha i + \beta j + Єij$$

Where: Xij = an observation, μ= overall mean, αi= replicates effect, βj = bedding type effect and Єij = experimental random error.

3. Results and Discussion

3.1. Body weight (BW) and body weight gain (BWG):

Data of the BW and BWG are presented in Tables (1 and 2). There are significant differences (P≤0.05) in BW of birds as affected by litter type at 6 weeks of age. The BW for birds raised on wheat straw, corn stalks chips and palm spines chips litters had significantly (P≤0.05) higher BW at 6 the week of age as compared to those grown on rice hulls and chopped palm fiber litters, while wood sawdust litter group had intermediate value. The overall means of BWG, showed significant increase for birds raised on wheat straw, wood sawdust, corn stalks chips and palm spines chips litters compared with those raised on rice hulls and chopped palm fiber litters. The reduction in growth for birds reared on rice hulls or chopped palm fiber litters may be due to increased leg disorders and feet lesions that make birds unable to walk and reach feeders and waterers. It has been indicated that broilers with severe foot lesions show slower live weight (**Amer, 2020**).

The present results are in partial agreement with those of **Atencio *et al.*, (2010), Yildiz *et al.* (2014)**, **Shepherd *et al.* (2017)**, **Lonkar *et al.* (2018)** and **Monckton, *et al.*, (2020**) who found that wood sawdust is associated with significant heavier BWG at 5-6 weeks of age as compared with those raised on straw based litters. In contrast, **Grimes *et al.*, (2006), Avila *et al.*, (2008), Davis *et al.*, (2010), Farghly (2012) and Farghly *et al.* (2015& 2020**) reported insignificant differences in BW of broilers, quails and turkeys raised on different alternative litter materials. Moreover , **Kuleile *et al.*, (2019)** found that litter material treatment had no significant influence on body weight gain.

3.2. Feed consumption (FC) and feed conversion ratio (FCR):

The results of Table 3 showed no significant differences in FC among the experimental groups; however the mean of FC birds raised on wheat straw and chopped palm fiber litters during from 5 to 6 weeks of age were significantly (P≤0.05) increased than that of birds raised on wood sawdust, corn stalks chips and palm spines chips litters, while rice hulls litter group

had intermediate value. During the periods from 5 to 6 weeks of age, the averages of FCR for birds raised on wheat straw, wood sawdust, corn stalks chips and palm spines chips litters had significantly (P≤0.05) better values than that of birds raised on rice hulls and chopped palm fiber litters. The overall means of FCR for birds raised on wheat straw, wood sawdust, corn stalks chips and palm spines chips litters significantly (P≤0.05) improved than that of birds raised on rice hulls litter, while birds raised on chopped palm fiber litter had intermediate value (Table 4).

The obtained results of the effect of litter types on the FC are in agreement with the findings of **Toledo *et al.,* (2019)** who, showed insignificant differences in FC of broilers, compared to wood sawdust. Subgroup meta-analysis revealed that straw, when used as an alternative litter material to wood sawdust, may be responsible for worse feed conversion. Also, **Nawar *et al.,* (2019**) reported that there were no significance differences in feed consumption. Similar results were obtained by **Mohammed *et al.,* (2019) and Balaban and Rathert (2020**). **Munir *et al.,* (2019)** and **Farghly *et al.* (2020**) found that the birds show improvement in different performance parameters, for example, up to 5-7% improvement in FCR. Similarly, **Amer *et al.,* (2015)** found that significant differences (P ≤ 0.05) among broilers of litter types in FC and FCR. The findings achieved by **Ramadan and Khloya (2017)** indicated that litter type had no obvious effect over feed conversion ratio. Contrary to our results, **Dhaliwal *et al.,* (2018)** reported that differences in FC and FCR of wheat straw, rice husk, mustard stalk groups were significantly higher that for sand.

3.3. Carcass characteristics:

Date presented in Table (5) showed no significant differences were found in dressed carcass, giblets and thymus percentages which could be owed to the type of litter. The lowest abdominal fat % is observed for broilers raised on wood sawdust, corn stalks chips and chopped palm fiber litters in comparison with those raised on wheat straw litter, while birds raised on rice hulls and palm spines chips litters had intermediate values. Concerning, the immune organs, birds raised on wheat straw and wood sawdust litters had a significantly (P≤0.05) increase in bursa percentage than those of birds raised on rice hulls and chopped palm fiber litters. Broilers raised on wood sawdust and chopped palm fiber litters significantly (P≤0.05) increased in spleen than those of birds raised on rice hulls litter.

The results of the present work are in agreement with findings of **Bilgili *et al.* (2009), Huang *et al.* (2009), Atencio** et ***al.*** **(2010), Davis *et al.* (2010), Farghly (2012), Farghly *et al.,* (2015) and Farghly *et al.* (2018& 2020)**. On the other hand, **Demirulus (2006**) found that carcass weight and carcass yield of a pine sawdust group were significantly higher than those reared on straw and mixed litter. **Toghyani *et al.* (2010)** indicated that gizzard percentages of broiler were not affected by litter type. Litter moisture content may influence carcass yield and may cause carcass lesions (**Traldi *et al.,* 2007**).

3.4. Body measurements and health status:

The results presented in Table (6), showed that the keel bone length for birds raised on wood sawdust, corn stalks chips and palm spines chips litters had significantly (P≤0.05) higher keel length as compared to those for chopped palm fiber litter, while birds raised on wheat straw and rice hulls litters groups had intermediate value. However, the lowest leg problems score is observed for broilers raised on corn stalks chips litter in comparison with those raised on rice hulls and chopped palm fiber litters, while birds raised on wood sawdust, wheat straw and palm spines chips litters had intermediate values of leg problems.

Birds with leg problems or disorders (foot sores and hock burns) spend more time sitting and, if the litter is wet and dirty with faeces, thes results in burns and sores. Foot and hock burns in turn reduce walking activity because they

make walking painful. The ability of the bedding to absorb and quickly release moisture and ammonia may be the most important characteristics (**Farghly *et al.* 2015** & **2020**)). Several studies suggested a strong association between "poor" litter quality and foot pad dermatitis (**Bilgili *et al.*, 2009). Petek *et al.* (2014)** indicated that the litter type had significant effect on length of foot pad lesions of the birds litter moisture. The present results are in acordance with those obtained by **Davis *et al.* (2010) Farghly (2012) and Farghly *et al.* (2015)** who found that litter type had significant effect on hock burn scores, foot pad dermatitis and walking ability. **Bilgili *et al.* (2009**) claimed that incidence of footpad dermatitis paralleled high litter moisture and caking scores. Similar results for breast bristers score were observed by **Farghly (2012).** However, **Yildiz *et al.* (2014)** indicated that the litter material had insignificant effect on feathering score.

3.5. Economic efficiency:

The results presented in Table (7), showed that, birds raised on corn stalks chips, palm spines chips and wood sawdust litters had higher economic efficiency than those of birds raised on rice hulls or chopped palm fiber litter, since, the values of relative economic efficiency were 105.4, 105.4 and 103.07 for corn stalks chips, palm spines chips and wood sawdust litters, respectively. Management strategies should focus on what is the best for poultry welfare and growth performance (**Mohammed *et al.*, 2019**). **Amer *et al.*, (2015)** and **Farghly (2017)** reported that litter type had significant effect on economic efficiency.

In conclusion, depends on the economic efficiency and availability palm spines chips litter can be used as litter material instead of wood sawdust and wheat straw. In conclusion, corn stalks chips and palm spines chips can potentially be used as alternative litter materials in New Valley for growing broilers.

Table (1): Means ±SE of body weight (g) as affected by different litter types.

Age (wks) / Litter materials	Body weight (g)						
	1 day	1 wk	2 wk	3 wk	4 wk	5 wk	6 wk
Wheat straw	41.9	160.4	440.6	891.2	1385.3	1792.2	2143.9^{a}
Wood sawdust	42.2	159.9	459.8	900.7	1382.8	1802.6	2125.6^{ab}
Rice hulls	40.9	154.7	430.6	878.9	1340.7	1762.3	1921.3^{b}
Corn stalks chips	42.1	166.9	443.1	892.3	1401.3	1798.2	2140.2^{a}
Chopped palm fiber	41.8	168.8	420.4	883.6	1372.2	1757.1	1928.1^{b}
Palm spines chips	42.3	158.5	448.9	906.4	1400.4	1805.3	2139.3^{a}
SEM	1.11	9.32	19.65	29.79	33.63	41.51	44.15
P value	0.6224	0.3279	0.7226	0.9842	0.5851	0.1965	0.0256

a-----c Means within columns followed by different superscripts are significantly different (P≤ 0.05).

Table (2): Means ±SE of body weight gain as affected by different litter types.

Age (wks) / Litter materials	Body weight gain (g/bird/day)						
	0-1	1-2	2-3	3-4	4-5	5-6	Mean
Wheat straw	16.93	40.03	64.37	70.59	58.13^{ab}	50.24^{a}	50.05^{a}
Wood sawdust	16.81	42.84	62.99	68.87	59.97^{a}	46.14^{ab}	49.60^{a}
Rice hulls	16.26	39.41	64.04	65.97	60.23^{a}	22.71^{c}	44.77^{b}
Corn stalks chips	17.83	39.46	64.17	72.71	56.70^{ab}	48.86^{a}	49.95^{a}
Chopped palm fiber	18.14	35.94	66.17	69.80	54.99^{b}	24.43^{bc}	44.91^{b}
Palm spines chips	16.60	41.49	65.36	70.57	57.84^{ab}	47.71^{a}	49.93^{a}
SEM	2.56	3.82	4.95	5.65	6.11	5.22	4.24
P value	0.6532	0.1568	0.2582	0.6125	0.0285	0.0482	0.03581

a-----c Means within columns followed by different superscripts are significantly different (P≤ 0.05).

Table (3): Means ±SE of feed consumption as affected by different litter types.

Age (wks) / Litter materials	Feed consumption (g/bird/day)						
	0-1	1-2	2-3	3-4	4-5	5-6	Mean
Wheat straw	28.86	60.24	91.04	110.22	121.63	129.16 [a]	90.19
Wood sawdust	27.91	58.43	89.22	108.81	119.81	124.24 [b]	88.07
Rice hulls	30.18	61.42	90.68	112.32	120.12	126.53 [ab]	90.21
Corn stalks chips	27.22	57.61	87.22	106.91	124.22	123.18 [b]	87.73
Chopped palm fiber	29.86	59.25	88.95	112.11	122.46	130.06 [a]	90.45
Palm spines chips	26.91	58.12	86.41	107.54	118.25	124.21 [b]	86.91
SEM	2.15	2.62	3.98	4.15	5.86	5.92	4.85
P value	0.8139	0.6521	0.4589	0.8262	0.1265	0.0282	0.26543

a---b Means within row followed by different superscripts are significantly different (P≤ 0.05).

Table (4): Means ±SE of feed conversion ratio as affected by different litter types.

Age (wks) / Litter materials	Feed conversion (g feed/g gain)						
	0-1	1-2	2-3	3-4	4-5	5-6	Mean
Wheat straw	1.70	1.50	1.41	1.56	2.09	2.57 [c]	1.81 [b]
Wood sawdust	1.66	1.36	1.42	1.58	2.00	2.69 [bc]	1.79 [b]
Rice hulls	1.86	1.56	1.42	1.70	1.99	5.56 [a]	2.35 [a]
Corn stalks chips	1.53	1.46	1.36	1.47	2.19	2.52 [c]	1.75 [b]
Chopped palm fiber	1.65	1.65	1.34	1.61	2.23	5.32 [ab]	2.30 [a]
Palm spines chips	1.62	1.40	1.32	1.52	2.04	2.60 [b]	1.75 [b]
SEM	0.08	0.11	0.10	0.09	0.12	0.07	0.06
P value	0.1562	0.5924	0.1562	0.6552	0.4938	0.0132	0.0249

a---c Means within row followed by different superscripts are significantly different (P≤ 0.05).

Table (5): Means ±SE of carcass traits as affected by different litter types.

Traits / Litter materials	Carcass traits, %			Immune organs, %		
	Dressing	Giblets	Abd. fat	Spleen	Bursa	Thymus
Wheat straw	75.12	5.21	2.20 [a]	0.246 [ab]	0.486 [a]	0.213
Wood sawdust	74.90	5.11	1.31 [b]	0.284 [a]	0.478 [a]	0.202
Rice hulls	74.48	4.96	1.87 [ab]	0.202 [b]	0.365 [b]	0.185
Corn stalks chips	75.00	5.15	1.30 [b]	0.242 [ab]	0.434 [ab]	0.204
Chopped palm fiber	74.39	5.02	1.24 [b]	0.279 [a]	0.352 [b]	0.196
Palm spines chips	75.06	5.16	1.76 [ab]	0.241 [ab]	0.423 [ab]	0.202
SEM	4.61	0.10	0.46	0.03	0.06	0.05
P value	0.4975	0.6132	0.0261	0.0352	0.0185	0.6241

a---b Means within columns followed by different superscripts are significantly different (P≤ 0.05).

Table (6). Means ±SE of body measurements and health status as affected by different litter types.

Treatments	Body measurements (cm)			Health status	
	Body depth	Keel bone	Shank	Breast blisters	Leg problems
Wheat straw	15.88	12.92 [ab]	6.08	1.60	2.00 [ab]
Wood sawdust	15.96	13.80 [a]	6.10	2.00	1.80 [ab]
Rice hulls	15.52	13.14 [ab]	5.86	2.20	2.40 [a]
Corn stalks chips	16.08	13.82 [a]	6.22	1.60	1.20 [b]
Chopped palm fiber	15.64	12.60 [b]	5.94	2.00	2.40 [a]
Palm spines chips	16.12	13.70 [a]	6.12	1.80	1.40 [b]
SEM	1.86	1.21	0.52	0.59	0.31
P value	0.7543	0.0242	0.1562	0.8712	0.0412

a---b Means within columns followed by different superscripts are significantly different (P≤ 0.05).

Table (7). Economical efficiency of broilers as affected by different litter types.

Items		Treatments					
		C	T1	T2	T3	T4	T5
Total costs/ bird/L.E	Litter costs/bird (L.E)	0.40	0.22	0.15	0.06	0.12	0.06
	Feed costs (L.E/bird)	25.00	24.41	25.01	24.32	25.07	24.09
	Total costs/ bird/L.E	25.40	24.63	25.16	24.38	25.19	24.69
Selling price of live bird at 6 weeks of age (L.E)		62.17	61.64	55.71	62.07	55.92	62.04
Net revenue/ bird/L.E (without *constant costs=25%)		**36.8**	**37.0**	**30.6**	**37.7**	**30.7**	**37.4**
Economical efficiency/bird (EE)		**1.47**	**1.52**	**1.22**	**1.55**	**1.23**	**1.55**
Relative economical efficiency/bird (REE)		**100.0**	**103.07**	**83.09**	**105.4**	**83.31**	**105.40**

Cost of 1 kg live body weight = 29.00 L.E. Price of 1 kg ration = 6.6 L.E L.E = Egyptian pound.
*Constant costs include: housing, labour, heating, cooling, lighting and treatment regimens.

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الملخص العربى

استخدام بعض مخلفات النخيل المتاحة فى الوادى الجديد كمواد فرشة بديلة لتربية دجاج التسمين

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أجريت هذه الدراسة لتقييم تاثير استخدام بعض المتبقيات النباتية كمواد فرشة بديلة متاحة فى الوادى الجديد على اداء النمو, صفات الذبيحة, الحالة الصحبة و الكفاءة الاقتصادية لدجاج التسمين. 180 كتكوت تسمين عمر يوم (كب– 500) قسمت إلي ستة مجاميع (3 مكررات لكل مجموعة) طبقا لمعاملات الفرشة. كتاكيت المجموعة الأولى كمجموعة مقارنة ربيت على فرشة من تبن القمح, أما مجاميع المعاملات الأولى, الثانية, الثالثة و الرابعة و الخامسة, فربيت الكتاكيت فيها على فرشة من نشارة الخشب, قش الارز, تبن سيقان الذرة (البوص), قطع الياف النخيل و قطع زعف النخيل المقصوص علي التوالي. نتائج اداء النمو (وزن الجسم, والزيادة فى وزن الجسم, استهلاك الغذاء و الكفاءة التحويلية) فى الفترات النهائية او فى عمر التسويق تعرض اختلافات معنوية بين مجاميع انواع الفرشة. الكتاكيت التى ربيت على فرشة من تبن القمح, تبن سيقان الذرة و قطع زعف النخيل المقصوص تفوقت معنويا فى وزن الجسم, والزيادة فى وزن الجسم عن الكتاكيت التى ربيت على فرشة من نشارة الخشب, قش الارز وقطع الياف النخيل. ايضا الكفاءة التحويلية للكتاكيت التى ربيت على فرشة من تبن القمح, نشارة الخشب, تبن سيقان الذرة و قطع زعف النخيل المقصوص تفوقت معنويا عن الكتاكيت التى ربيت على فرشة من قش الارز قطع الياف النخيل. عدم وجود اختلافات معنوية بين جميع المعاملات فى تصافى الذبيحة, بينما اقل نسبة دهن فى التجويف البطنى لوحظت فى الكتاكيت التى ربيت على فرشة من نشارة الخشب, تبن سيقان الذرة و قطع الياف النخيل. الكتاكيت التى ربيت على فرشة من نشارة الخشب, تبن القمح اعطت زيادة معنوية فى نسبة البرسا عن الكتاكيت التى ربيت على فرشة من قش الارز و قطع الياف النخيل. طول عظمة القص كانت اعلى معنويا للكتاكيت التى ربيت على فرشة من نشارة الخشب, تبن سيقان الذرة و قطع زعف النخيل المقصوص مقارنة بالكتاكيت التى ربيت على فرشة من قطع الياف النخيل. اقل حدوث مشاكل الارجل لوحظت فى الكتاكيت التى ربيت على تبن سيقان الذرة مقارنة بالكتاكيت التى ربيت على فرشة من قش الارز و قطع الياف النخيل. بناءا على الكفاءة الاقتصادية و اتاحة قطع زعف النخيل المقصوص يمكن ان تستخدم كمواد فرشة بدلا من تبن القمح او نشارة الخشب. نخلص من النتائج ان استخدام كلا من سيقان الذرة (البوص) و قطع زعف النخيل المقصوص كمواد فرشة بديلة لرعاية كتاكيت التسمين فى الوادى الجديد.