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EVALUATION OF CLOVER AND CORN STALKS STRAW AS ALTERNATIVE LITTER MATERIALS TO WHEAT STRAW FOR RAISING LOCAL TURKEY

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SUMMARY

A total number of one hundred and eighty birds aged 8 weeks were randomly assigned into three equal groups to investigate the effect of using clover and corn stalks straw as alternative litter materials on growth performance, carcass characteristics, leg problems, breast blisters, airborne and litter conditions of local turkey. Birds in the first group were raised on wheat straw litter and were considered the control (C). While the second, and third groups (T1 and T2) were raised on clover and corn stalks straw, respectively. All experimental birds were raised under similar environmental and managerial conditions. Body weight, body weight gain, feed consumption, feed conversion, carcass weights, airborne dust particulates, litter pH and bacterial count were not different between treatments. However, the incidence of leg problems and breast blisters were decreased with clover litter. Otherwise, corn stalks chips decreased litter moisture percentage, caking score and ammonia concentrations inside the poultry house, which positively reflected on the health condition of the birds. From these results and economical efficiency, it could be concluded that, using clover and corn stalks straw as economical alternative litter materials for local turkey is highly recommended.

Keywords: Growth performance, clover and corn stalks straw, litter type, local turkey

INTRODUCTION

Poultry litter is considered as one of the most important and integral elements in providing the proper environment inside the building to achieve efficient performance of poultry (Carr *et al.,* 1990; Dawkins *et al.,* 2004). The quality of litter material directly affects the performance, health, carcass quality, and welfare of the poultry especially in turkey (Malone *et al.*, 1982, 1983; Malone and Chaloupka, 1983; Veltman *et al.,* 1984; Hester *et al*., 1987). An ideal litter material should be dry with higher water-holding capacity but should also be able to release the absorbed moisture quickly. Factors which can influence the efficiency of litter type include; particle size, moisture content, pH, caking rate, litter depth, site drainage, house condensation problems, improper management of the drinkers, cooling and ventilation systems, and stocking density. Litter material with too high a moisture level could increase the risk of pathogenic microbial growth and increase ammonia production (Carlile, 1984). Increased dustiness, resulting from bedding materials that are too dry, makes the poultry more susceptible to respiratory diseases (Willis *et al.,* 1997). Therefore, any bedding materials has to be free from fungi, dust, toxic plant species, heavy metals and pesticides, it should not be harmful to poultry. Thus, the choice of material used as bedding depends largely on what is available, suitability, and cost in the localities where poultry is grown.

Wheat straw and wood shavings are the most effective litter material for poultry due to its suitability however, it is high cost and not available to meet the demand. So, it is necessary to search for other alternative litter materials (Al-Homidan and Robertson, 2007; Sharnam *et al.,* 2008; Davis *et al.,* 2010). Many alternative materials have been evaluated for litter ranging from wood by-products to waste materials (Burke *et al.,* 1993; Hermes *et al.,* 2004; Atapattu and Wickramasinghe, 2007; Grimes *et al.,* 2002; Atencio *et al.,* 2010). Many turkey farms have limited supplies of shavings and are either reusing brooder house litter or using alternative bedding materials, such as rice hulls, sunflower hulls, chopped wheat straw, or chipped cardboard, corncobs, cornstalks, sugarcane stalks, peat moss, peanut hulls, wood shavings, oat hulls and newspaper (Hester *et al*., 1987; Frame *et al.,* 2002; Grimes *et al.,* 2002; Puffinbarger, 2006).

The use of other plant residues as poultry litter has received considerable interest as the cost and difficulty of obtaining wheat straw (animal feed) based litter sources has increased. Although most of the studies on litter materials deal with their effects on production, a few of these have studied the using of litter type to alleviate harmful effects of ammonia levels, dusts and bacteria count in the poultry house. Therefore, the objective of

this study was to determine the feasibility of utilizing clover and corn stalks straw as alternative litter materials for raising local turkeys under the prevailing environmental conditions in Assiut, in an attempt to assure satisfactory and cost-effective bedding supplies.

MATERIALS AND METHODS

The present experiment was performed at the experimental Poultry Research Farm, Faculty of Agriculture, Assiut University, during twelve weeks experimental period. A total number of one hundred and eighty, 8 weeks old birds were randomly distributed into three equal groups (3 replicates of 20 birds each). This was done to investigate the effect of using clover and corn stalks straw as alternative litter materials on growth performance, carcass characteristics, leg problems and breast blisters of local turkeys. Birds in the first group were raised on wheat straw litter and were considered the control group (C), while the second and third groups (T1 and T2) were raised on clover and corn stalks straw, respectively. All experimental birds were raised under similar environmental and managerial conditions on deep litter of 8-10 cm thickness. Birds were exposed to 12 light hrs/day with intensity 5-10 Luxes. Feed and water were available all the time. Birds were fed a basal diet, (24.0% crude protein, 2900 kcal ME/kg diet, 2.71% crude fiber, 1.61% Ca and 0.67% available phosphorus) from 8 week until 20 weeks of age (Table 1).

The body weights (BW) on individual basis, at 8, 10, 12, 14, 16, 18 and 20 weeks of age were recorded. The average body weight gain (BWG) and feed consumption (FC) were calculated biweekly from 8 to 20 weeks of age. The feed conversion ratios (g feed/g gain, FCR) were calculated periodically every two weeks, from 8 to 20 weeks of age. Dead birds were recorded daily and expressed as percentage during the experimental period. At 20 weeks of age, 6 birds (male) per group were randomly chosen, and fasted for 6 hours before slaughtering. The internal organs (Heart, liver and empty gizzard) were removed and weighed. Carcass weight was calculated as percentages of pre-slaughter live body weight, while body organs (heart, liver, gizzard and giblets) were calculated as percentages of carcass weight. A total number of thirty six litter samples i.e twelve samples were taken from each treatment to determine the bacterial count in the litters when the birds were 8, 12, 16 and 20 weeks old, according to Klement *et al.* (1990). The moisture content and pH of different litter samples were also determined at the same time. The litter samples were analyzed for moisture content and pH by using methods adopted by Brake *et al.* (1992).

To determine pH: 10 gm of litter samples were suspended in 100 ml deionised water for 30 minutes. pH value was recorded until constant values were obtained. A total number of twenty seven samples were taken biweekly to determine the concentration of airborne ammonia inside the poultry house, using nine samples from each group (three from each replicate) which were taken at 10 AM, according to Nodvor (1976). Similarly, as mentioned by the ammonia determination, 48 litter samples for estimating the concentration of suspended airborne dust particulates, expressed as mg/m^3 in the experimental rooms were performed by using a specialized apparatus (Laser dust monitor calibration, model LD-1 (H), No PS-33).

At 16 wk of age, 10 birds per pen were examined and scored (on a scale of 1 to 5) for hock discoloration, foot pad burns and breast blisters. The scoring systems for hock discoloration and foot pad burns were adapted and modified from the reports of Andrews (1972) and Carter *et al.* (1979). The scores ranged from 1 = no hock discoloration or foot pad burn to 5 = total coverage of red discoloration of the hock or total foot pad involvement in a foot pad burn. Similarly, 2 people scored (on a scale of 1 to 5) each pen for the amount of litter cake, where 1 = no litter cake to 5 = total pen coverage of caked litter.

Economical efficiency was based on the costs of the feed and light consumed and the income/bird (body weight). The net revenue per bird was estimated as the difference between the total income/bird (LE), (weight gain) and the total costs of feed and litter. The costs of the used feed were calculated according to the actual prices prevailing in the Egyptian market during the experiment. Data collected were subjected to analysis of variance by applying the General Linear Models Procedure of SAS software (SAS Institute, version 6.12, 1996). Duncan (1955) was used to detect differences among means of different groups. The percentages of carcass and organs were transformed to Arcsin values. The following model was used for analysis of variance: $Y_{ij} = \mu + S_i + e_{ij}$

Where: Y_{ij} = observation, μ = overall mean, S_i = treatment effect, e_{ij} = experimental errors.

RESULTS AND DISCUSSSION

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

From data presented in Table (2), it is clearly noted that the differences in body weight and body weight gain between litter

materials were not significant (P>0.05) at all ages. Numerous studies have evaluated wheat straw as a litter material for commercial poultry production (Chaloupka *et al.,* 1967; Nakaue *et al.,* 1978; Malone, 1992; Bilgili *et al.,* 2009; Torok *et al.,* 2009). The results are in partial agreement with those found by Nakaue *et al.,* (1978), Enueme *et al.* (1987), Lien *et al.,* (1992), Burke *et al.* (1993), Martinez and Gernat (1995), Sengül *et al*. (1996), Lien *et al.*, (1998), Swain and Sundaram (2000), Smith (2002), Chamblee and Yeatman (2003), Grimes *et al.* (2006), Avila *et al.* (2008), Atapattu and Wickramasinghe (2007) and Davis *et al.* (2010). They found no significant differences in BW and BWG of broilers and turkeys raised on different alternative litter materials.

Other researchers (Wyatt and Goodman, 1992) have reported that growth performance was unaffected by litter types, including recycled paper, pine shavings, refined gypsum, and hardwood bark. In the same line, Bilgili *et al.* (2009) found that bedding materials (pine shavings, pine bark, chipped pine, mortar sand, ground hardwood pallets, chopped straw, ground door filler, and cotton-gin trash) had little influence on the live performance of broilers. On the other hand, bedding type was found to significantly affect growth performance of broilers (Malone *et al.,* 1982 and 1983; Demirulus *et al.,* 1998; Bilgili *et al.,* 1999a; Bilgili *et al.,* 1999b; Anisuzzaman and Chowdhury, 1996; Al-Homidan and Robertson, 2007; Grimes *et al.,* 2007; Huang *et al.,* 2009; Torok *et al.,* 2009 and Atencio *et al.,* 2010). Moreover, Grimes *et al.,* (2006) showed that growth performance might be negatively affected by caking over of litter.

Feed consumption (FC) and feed conversion (FCR):

The results presented in Table (2), show no significant differences (P>0.05) in FC and FCR at all ages, expect at 12-14. The average FCR of T1 and T2 were significantly (P≤0.05) better than those of the C group during the period from 12-14 weeks of age by 15.9 and 15.5 %, respectively. These results are in agreement with the findings of Nakaue *et al.* (1978), Sengül *et al.* (1996), Bilgili *et al,* (1999a), Chamblee *et al.* (2000), Swain and Sundaram (2000), Smith (2002), Chamblee and Yeatman (2003), Atapattu and Wickramasinghe (2007), Bilgili *et al.* (2009), Torok *et al.* (2009) and Davis *et al.* (2010). They reported found that FC and FCR were not affected by litter type. Other researchers have reported similar findings in regards to the influence of various litter materials on FCR (Burke *et al.,* 1993; Willis *et al.,* 1997; Grimes *et al.*, 2006; Al-Homidan and Robertson, 2007 and Atapattu and Wickramasinghe, 2007). On the other hand, Lien *et al.* (1992), Martinez and Gernat (1995), Bilgili *et al.* (1999a), Demirulus, (2006), Huang *et al.* (2009), Torok *et al.* (2009) and Atencio *et al,* (2010) found significant differences in FC and FCR among birds raised on different litter materials.

Carcass traits:

The results of carcass traits are presented in Table 3. It could be observed that no significant (P>0.05) differences existed in the percentages of carcass traits. These results are in agreement with findings of Lien *et al.* (1992), Sengül *et al.* (1996), Willis *et al.* (1997), Demirulus *et al.* (1998), Bilgili *et al.,* (1999b), Atapattu and Wickramasinghe (2007), Bilgili *et al.* (2009), Huang *et al.* (2009), Atencio *et al.* (2010) and Davis *et al.* (2010). They reported that carcass, thighs, wings, back, heart, liver and gizzard percentages of broiler chickens and turkeys were not affected by litter type including wheat straw. However, Demirulus *et al.* (1998) found better carcass, breast, abdominal fat and neck weights for wheat straw litter. On the contrary, Billgilli *et al.* (1999b) and Malone *et al.* (1983) reported that bedding type can significantly affect carcass quality of broilers. They found that broilers reared on wood shavings or sawdust has been shown to have larger gizzards than those reared on other litter materials. Mutaf *et al.* (1980) obtained the best carcass yield from pine shaving+straw. Demirulus (2006) found that live weight and carcass weight, heart weight, liver, gizzard weight, and carcass yield of a pine shaving group were significantly higher than those reared on straw and mixed litter. Also, he obtained desired lowest abdominal fat level from pine shavings than straw and mixed litter.

Leg problems and breast blisters:

The data presented in Table (4), showed that, foot pad burns, hock discoloration and breast blisters score for the C, T1 and T2 groups were not signfficantly affected by bedding material. Many factors affect footpad dermatitis such as litter quality (Hester *et al*., 1987; Sørensen *et al.,* 1999; Su *et al.,* 1999; Mayne, 2005; Pagazaurtundua, and Warris 2006; Haslam, *et al.,* 2007; Meluzzi, *et al.,* 2008). Bedding materials with sharp edges (large particle-size wood chips, chopped straw, etc.) may contribute to footpad dermatitis and leg problems through their abrasive action. Similar results had been observed by Enueme *et al.* (1987), Su *et al.* (2000), Frame *et al.* (2002), Smith (2002) and Davis *et al.* (2010). They found that litter type had significant effect on hock burn scores, foot pad dermatitis and walking ability. Haslam, *et al.* (2006) and

Bilgili *et al.* (2009) found that incidence of footpad dermatitis paralleled high litter moisture and caking scores. Chipped pine, chopped straw, cotton-gin trash, and pine shavings had the highest severity scores and mortar sand and ground door filler showing the lowest.

The ability of the bedding to absorb and quickly release moisture and ammonia may be the most important characteristics. This effect may be directly associated with the ability of bedding to shield footpads from continuous contact with moisture, thereby minimizing footpad softening and susceptibility to irritation and inflammation. Eight different litter materials were evaluated to determine their effects on incidence and severity of foot pad dermatitis, including chopped wheat straw (Hester *et al*., 1987). With regard to the breast blisters, similar results were observed by Malone *et al.* (1982) and Malone and Gedamu (1995). In contrst, Nakaue *et al.* (1978) reported that breast blisters were similar for wheat straw and wood shavings. Also, Grimes *et al.* (2006) found no differences in breast blister, hock condition and foot pad condition index due to litter materials.

Mortality:

The data presented in Table (4), showed that, there were no significant differences in mortality rates between treatments. These results are in agreement with those obtained by Veltmann *et al.,* (1984), Burke *et al.,* 1993, Martinez and Gerant 1995, Sengül *et al.,* 1996; Hester *et al.,* 1997, Willis *et al.,* 1997; Lien *et al.,* 1998; Bilgili *et al.,* 1999a; Chamblee *et al.,* 2000; Grimes *et al.,* 2006; Atapattu and Wickramasinghe, 2007 and Atencio *et al.,* 2010). They reported no significant differences in mortality rates of turkeys and broilers raised on different litter materials. Moreover, Bilgili *et al.* (2009) and Davis *et al.,* (2010) found that mortality was not different between litter materials. In contrast, Malone and Chaloupka (1983) observed that broilers raised on hardwood sawdust had significantly higher mortality than those raised on processed newspaper. Huang *et al.,* (2009) found that the bursa of fabricius, white blood cells, and lymphocyte concentrations were not altered consistently by any litter type.

Litter quality:

The litter quality results (caking rate, pH and bacterial count) presented in Table (5) revealed significant ($P \leq 0.05$) differences in moisture content (MC) of tested litter types during the 16th and 20th weeks of age. No significant ($P > 0.05$) differences existed in litter pH, bacterial count and caking rate. Dawkins *et al.* (2004) found that poor litter condition had more direct impact on poultry performance and welfare. Caked and wet litter is generally recognized as having a much greater negative impact on performance, health, and overall profitability. Ideally, litter should be managed to have 25 percent moisture (Malone, 2006). Nakaue *et al.* (1978) determined that cereal straw holds 3.5 times the water of shavings and caked more.

Atencio *et al.* (2010) found that sand maintained approximately 15% lower moisture level in comparison to pine wood shavings and rice hulls. The present study indicated that the wheat and clover straw litter allowed for easier caking than was the case with the corn stalk straw. The moisture level (Malone *et al.,* 1982; Wang *et al.,* 1998; Mayne, 2005) as well as the physical appearance of the material (Lien *et al.,* 1992) affects the degree of litter cake formation and footpad dermatitis.

Coliforms, aerobic, anaerobic and enteric bacterial counts were low in sand litter (Bilgili *et al.,* 1999a and Macklin *et al.,* 2005). The results of Whyte (1993) revealed that poultry litter contains both Gram-positive and Gram-negative bacteria. He stated that the various species of microorganisms in the litter include Coliform, Pseudomonas, Aeromonas, and Micrococcus luteus are affected by litter type and age, moisture and temperature of litter. Lien *et al.* (1992) and (1998) observed that bacteria populations were not affected by litter type; while, Malone *et al.* (1983) found that litter type affects litter bacteria. Excessive moisture promotes bacterial growth, which will decompose organic material producing ammonia, a highly irritating and toxic gas (Wathes, 1998; Kristensen and Wathes, 2000). On the other hand, very wet conditions may slow/shut down microbial and enzymatic activities due to scarcity of oxygen.

The pH value of litter is one of the most important factors that determines the aqueous phase ammonia concentration, and therefore influences ammonia release. Research has demonstrated that ammonia release from litter is negligible at litter pH below 7 (Reece *et al.,* 1985). Litter moisture and caking have been identified as major contributing factors to footpad dermatitis (FPD) in poultry (Wang *et al.,* 1998; Mayne *et al.,* 2007). Mayne *et al.,* (2007) clearly demonstrated that high litter moisture alone was sufficient to cause FPD in young turkeys. On the other hand, Smith (2002) and Grimes *et al.* (2006) found no differences in incidence of litter caking and condition by litter type.

Airborne quality:

The results of airborne quality (ambient temperature, humidity, ammonia and airborne dust particulates concentrations) are shown in

Table (6). It revealed no significant differences in ammonia concentration (AC) and airborne dust particulates concentrations (DC) for birds raised on the tested litter types except during the 20th weeks for the AC. Litter management and its indirect effect on air quality has a major influence on poultry health. Wang *et al.* (1998) found that air humidity ranged from 74% to 94% and that it was correlated with litter moisture and air temperature. The increases in temperature and litter moisture were paralleled by increased humidity. When air temperature was above 20°C, increasing litter moisture content was associated with increasing incidence of foot pad dermatitis.

Ammonia is formed from the break down of nitrogenous wastes in the litter organic materials by microorganisms. Ammonia emissions from poultry litter can not only cause environmental problems, but also be detrimental to the health, welfare, and performance of birds (Oyetunde *et al.,* 1976; Caveny *et al.,* 1981; Nagaraja *et al.,* 1983; Carlile, 1984; Donham, 2000; Ni *et al.,* 2010). Factors that directly control the ammonia formation are pH, temperature, and moisture level of the litter (Carr *et al.,* 1990; Liu *et al.,* 2007; Miles, *et al.,* 2007). Similarly, Lien *et al.* (1998), Al-Homidan and Robertson, (2007) and Atapattu *et al.* (2008) found significant difference in ammonia concentrations by different litter types. On the other hand, Nakaue *et al.* (1978), Chamblee and Yeatman (2003) and Grimes *et al.* (2006) found no differences in ammonia levels due to litter type.

The obtained results of dust levels agree with the findings of Nakaue *et al.* (1978), Willis, *et al.* (1997), Whyte (1993) and Wathes (1998). Dry, dusty litter may contribute to increase chick dehydration, respiratory disease, and condemnations (Malone, 2006). In contrast, Al-Homidan and Robertson (2007) found that the litter type had a negative significant effect on the dust production and suggested that this was probably due to variations in the moisture content and dustiness.

Economical efficiency:

The data presented in Table (7), showed that, the relative economical efficiency of birds raised on wheat straw, clover and corn stalks straw were 100, 93.3 and 102.4, respectively. This could be attributed to the superiority of corn stalk straw (T2) in growth performance. In addition, T2 litter slightly decreased the airborne dust and ammonia concentrations as well as litter moisture, which positively reflected on the immunity and health condition of the birds. Generally, it could be concluded that the use of clover and corn stalks straw as economical alternative litter materials for local turkey is highly recommended.

REFERENCES

AL-Homidan, A. and J.F., Robertson, 2007. The effect of stocking density and litter type on ammonia, dust, carbon dioxide concentrations and broiler performance. Egyption Poult. Sci., 27:37-51.

Andrews, L. D., 1972. Cage rearing of broilers. Poult. Sci., 51:1194–1197.

Anisuzzaman, M. and S.D. Chowdhury, 1996. Use of four types of litter for rearing broilers. Br. Poult. Sci., 37: 541–545.

Atapattu, N.S.B.M., D. Senaratna and U. D. Belpagodagamage, 2008. Comparison of ammonia emission rates from three types of broiler litters. Poult. Sci. 87:2436–2440.

Atapattu, N. S. B. M. and K. P. Wickramasinghe, 2007. The use of refused tea as litter material for broiler chickens. Poult. Sci., 86:968–972.

Atencio, J.L., J.A. FernЈndez, A.G. Gernat and J.G. Murillo, 2010. Effect of pine wood shavings, rice hulls and river bed sand on broiler productivity when used as a litter sources. Inter. J. of Poult. Sci. 9: 240-243.

Avila, V.S., U. Oliveira, E.A.P. Figueiredo, C.A.F. Costa, V.M.N. Abreu and P.S. Rosa, 2008. Alternative material to replace wood shavings as broiler litter, Rev. Bras. Zootecn. 37:273–277.

Bilgili, S. F., G. I. Montenegro, J. B. Hess, and M. K. Eckman., 1999a. Live performance, carcass quality, and deboning yields of broilers reared on sand as a litter source. J. Appl. Poult. Res. 8:352–361.

Bilgili, S.F., G.I. Montenegro, J.B. Hess and M.K. Eckman, 1999b. Sand as litter for rearing broiler chickens. J. Applied Poult. Res., 8: 345-351.

Bilgili, S.F., J.B. Hess, J.P. Blake, K.S. Macklin, B. Saenmahayak and J.L. Sibley, 2009. Influence of bedding material on footpad dermatitis in broiler chickens. J. Applied Poult. Res., 18: 283-589.

Brake, J.D., C.R. Boyle, T.N. Chamblee, C.D. Schultz and E.D. Peebles, 1992. Evaluation of the chemical and physical properties of hardwood bard used as a broiler litter material. Poult. Sci., 71: 467-472.

Burke, G.B., A.J. Pescatore, A.H. Cantor, M.L. Straw, H. Xianbai and T.H. Johnson, 1993. Newspaper as litter material and its effects on the performance of broilers. J. Applied Poult. Res., 2: 154-158.

Carlile, F.S, 1984. Ammonia in poultry houses: A literature review. World Poult. Sci., J. 40:99–113.

Carr, L. E., F. W. Wheaton, and L. W. Douglass, 1990. Empirical models to determine ammonia concentrations from broiler chicken litter. Trans. ASAE 33:1337–1342.

Carter, T.A., R.C. Allison, W.C. Mills and J.R. West, 1979. Wood chips for poultry litter. Poult. Sci., 58: 994-997.

Caveny, D. D., C. L. Quarles, and G. A. Greathouse, 1981. Atmospheric ammonia and broiler cockerel performance. Poult. Sci., 60:513–516.

Chaloupka, G.W., R.W. Loyd, J.F. Gordy and L.M. Greene, 1967. Evaluation of litter materials for broiler production. Poult. Sci., 46(abstract): 1242.

Chamblee, T.N. and J.B. Yeatman,, 2003. Evaluation of rice hull ash as broiler litter. J. Applied Poult. Res., 12: 424-427.

Chamblee, T.N., J.B., Yeatman, C., Hackett; and K. Phillips, 2000. Evaluation of rice hull ash as a litter material for broiler chickens. Poult. Sci., 79 (Suppl. 1):91 (Abstract).

Davis, J.D., J.L. Purswell, E.P. Columbus and A.S. Kiess, 2010. Evaluation of Chopped Switchgrass as a Litter Material. Inter. J. of Poult. Sci., 9: 39-42.

Dawkins, M. S., C. A. Donnelly and T. A. Jones, 2004. Chicken welfare is influenced more by housing conditions than by stocking density. Nature, 427:342–344.

Demirulus, H., 2006. The Effect of Litter Type and Litter Thickness on Broiler Carcass Traits. Inter. J. of Poult. Sci. 5: 670-672.

Demirulus, H., K. Kara, S. Eratak and C. Temur, 1998. The effects of density and litter type on growth performance of broilers. East Anatolia Agriculture congress. 14-15 September. Erzurum, 999-1008.

Donham, K.J., 2000. The concentration of swine production. Veterinary Clinics of North America: Food Anim. Pract., 16:559-597.

Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11:1-42.

Enueme, J. E., P. E. Waibel, and R. S. Farnham, 1987. Use of peat as a bedding material and dietary component for tom turkeys. Poult. Sci., 66:1508–1516.

Frame, D. D., R. E. Buckner, and G. L. Anderson 2002. Pelletized newspaper bedding for turkeys and its effect on brooding performance. J. Appl. Poult. Res., 11:229–232.

Grimes, J.L., T.A. Carter and J.L. Godwin, 2006. Use of a litter material made from cotton waste, gypsum, and old newsprint for rearing broiler chickens, Poult. Sci. 85, 563–568.

Grimes, J.L., J. Smith and C.M. Williams, 2002. Some alternative litter materials used for growing broilers and turkeys. World's Poult. Sci. J., 58: 515-526.

Grimes, J.L., T.A. Carter, A.E. Gernat and J.L. Godwin, 2007. A novel bedding material made from cotton waste, gypsum and old newsprint for rearing turkeys. J. Applied Poult. Res., 16: 598-604.

Haslam, S. M., S. N. Brown, L. J. Wilkins, S. C. Kestin, P. D. Warriss, and C. J. Nicol 2006. Preliminary study to examine the utility of using foot burn or hock burn to assess aspects of housing conditions for broiler chicken. Br. Poult. Sci., 47:13–18.

Haslam, S. M., T. G. Knowles, S. N. Brown, L. J. Wilkins, S. C. Kestin, P. D. Warris, and C. J. Nicol, 2007. Factors affecting the prevalence of foot pad dermatitis, hock burn and breast burn in broiler chicken. Br. Poult. Sci., 48:264–275.

Hermes, J. C., H. S. Nakaue, and A. M. Craig, 2004. Effect of feeding endophyte-infected feed and bedding on the performance of broilers. J. Appl. Poult. Res., 13:71–76.

Hester, P. Y., A. L. Sutton, and R. G. Elkin. 1987. Effect of light intensity, litter source, and litter management on the incidence of leg abnormalities and performance of male turkeys. Poult. Sci., 66:666–675.

Hester, P.Y.; L.D., Cassens; and T.A., Bryan, 1997. The applicability of particleboard residue as a litter material for male turkeys. Poult. Sci., 76:248-255.

Huang, Y., J. S. Yoo, H. J. Kim, Y. Wang, Y. J. Chen, J. H. Cho and I. H. Kim, 2009. Effect of bedding types and different nutrient densities on growth performance, visceral organ weight, and blood characteristics in broiler chickens. J APPL POULT RES 2009. 18:1-7.

Klement, Z., K., Rudolph, and D.C., Sands, 1990. Methods in phytobacteriology. Akademid Kiado, Budapest, pp 568.

Kristensen, H. H., and C. M. Wathes, 2000. Ammonia and poultry welfare: A review. World's Poult. Sci., J. 56:235–245.

Lien, R.J., D.E. Conner and S.F. Bilgili, 1992, The use of recycled paper chips as litter material for rearing broiler chickens, Poult. Sci., 71:81–87.

Lien, R.J., J.B. Hess, D.E. Conner, C.W. Wood and R.A. Shelby, 1998. Peanut hulls as litter source for broiler breeder replacement pullets, Poult. Sci., 77:41–46.

Liu, Z., L. Wang and D. Beasley, 2007. Effect of moisture content on ammonia emissions from broiler litter: A laboratory study. J. Atmos Chem, 58:41–53.

Macklin, K.S., J.B. Hess, S.F. Bilgili and R.A. Norton, 2005. Bacterial levels of pine

shavings and sand used as poultry litter, J. Appl. Poult. Res., 14:238–245.

Malone, B., 2006. Managing built-up litter. Proceedings to 2006 Midwest Poulry Fedration conference.

Malone, G.W., P.H. Allen, G.W. Chaloupka and W.F. Ritter, 1982. Recycled paper products as broiler litter, Poult. Sci., 61: 2161–2165.

Malone, G. W., and G. W., Chaloupka, 1983. Influence of litter type and size on broiler performance. 2. Processed newspaper litter particle size and management. Poult. Sci., 62:1747-1750.

Malone, G.W. and N. Gedamu, 1995. Pelleted newspaper as a broiler litter material. J. Applied Poult. Res., 4: 49-54.

Malone, G.W., 1992. Evaluation of litter materials other than wood shavings. Proceedings of the National Poultry Waste Management Symposium. National Poultry Waste Management Symposium Committee, Auburn, AL., 274-284.

Malone, G.W., G.W. Chaloupka and R.J. Eckroade, 1983. Composted municipal garbage for broiler litter. Poult. Sci., 62: 414-418.

Martinez, D.F. and A.G. Gernat, 1995. The effect of chopped computer and bond paper mixed with wood shavings as a litter material on broiler performance. Poult. Sci., 74: 1395-1399.

Mayne, R. K., 2005. A review of the aetiology and possible causative factors of foot pad dermatitis in growing turkeys and broilers. World's Poult. Sci., J. 61:256–267.

Mayne, R. K., R. W. Else and P. M. Hocking, 2007. High litter moisture is sufficient to cause footpad dermatitis in growing turkeys. Br. Poult. Sci., 48:538–545.

Meluzzi, A., C. Fabbri, E. Folegatti, and F. Sirri, 2008. Survey of chicken rearing conditions in Italy: Effects of litter quality and stocking density on productivity, foot dermatitis and carcase injuries. Br. Poult. Sci., 49:257–264.

Miles, D. M., P. R. Owens, P. A. Moore, Jr. and D. E. Rowe, 2007. Instrumentation for Evaluating Differences in Ammonia Volatilization from Broiler Litter and Cake. J Appl. Poult. res., 17:340-347.

Mutaf, S., T. Gönül and Ö. Yavas, 1980. The effect of various litter, mixture of these and grill on the productive characteristics. Ege University Agriculture Press, Nu.365, 27 p.

Nagaraja, K. V., D. A. Emercy, K. A. Jordan, V. Sivanandan, J. A. Newman, and B. S. Pomeroy, 1983. Scanning electron microscopic studies of adverse effects of ammonia on tracheal tissues of turkeys. Am. J. Vet. Res., 44:1530–1536.

Nakaue, H.S., C.M. Fischer and G.H. Arscott, 1978. Chopped cereal straw as a broiler floor litter. Oregon State University Report No. 509.

National Research Council, 1994. Nutrient requirements of poultry. 9th rev. ed National Academy press, Washington, DC.

Ni, J. Q., A. J. Hebera, S. M. Hanni, T. T. Lim and C. A. Diehl, 2010. Characteristics of ammonia and carbon dioxide releases from layer hen manure. Bri. Poult. Sci., 51:326 – 334.

Nodvor, D., 1976. Practice of hygiene with technical sanitary measures. Medicine, 7: 254-280.

Oyetunde, O. O. F., R. G. Thompson, and H. C. Carlson, 1976. Aerosol exposure of ammonia, dust and Escherichia coli in broiler chickens. Can. Vet. J., 19:187–193.

Pagazaurtundua, A., and P. D. Warris, 2006. Levels of foot pad dermatitis in broiler chickens reared in 5 different systems. Br. Poult. Sci., 47:529–532.

Puffinbarger, C., 2006. Nicholas Turkey Breeding Farms, Lewisburg, WV. Personal communication.

Reece, F.N., B.D. Lott and B.J. Bates, 1985. The performance of a computerized system for control of broiler-house environment. Poultry Sci. 64, 261–265.

SAS Institute, 1996. SAS® Users Guide, Version 6.12. SAS Institute, Cary, NC.

Sengül, T., T. Yildiz and Y. Konca, 1996. The effect of various litter materials on the productive performance in broiler production. J. Tec., Poult., 83: 31-38.

Sharnam, K.S., K.N. Wadhwani, K., Khanna and A.M. Patel, 2008. Effect of quality feeds and litter materials on broiler performance under hot humid climate. Inter. J. of Poult. Sci., 7: 14-22.

Smith, J.C., 2002. Chopped bermuda grass hay as an alternative bedding material for rearing market turkey hens. North Carolina State University, Raleigh, NC.

Sørensen, P., G. Su, and S. C. Kestin, 1999. The effect of photoperiod/ scotoperiod on leg weakness in broiler chickens. Poultry Sci., 78:336-342.

Su, G., P. Sørensen, and S. C. Kestin, 2000. A Note on the Effects of Perches and Litter Substrate on Leg Weakness in Broiler Chickens. Poult. Sci., 79:1259–1263.

Su, G., P. Sørensen and S. C. Kestin, 1999. Meal feeding is more effective than early feed restriction at reducing leg weakness in broilers. Poultry Sci., 78:949-955.

Swain, B.K., and R.N.S. Sundaram 2000. Effect of different types of litter material for rearing broilers. Br. Poult. Sci., 41: 261–262.

Torok, V.A., R.J. Hughes, K. Ophel-Keller, M. Ali and R. MacAlpine, 2009. Influence of different litter materials on cecal microbiota colonization in broiler chickens. Poult. Sci., 88: 2474-2481.

Veltmann, J.R., F.A. Gardener and S.S. Linton, 1984. Comparison of rice hull products as litter material and dietary fat levels on Turkey poult performance. Poult. Sci., 63: 2345-2351.

Wang, G., C. Ekstrand and J. Svedberg. 1998. Wet litter and perches as risk factors for the development of foot pad dermatitis in floor-housed hens. Br. Poult. Sci., 39:191–197.

Wathes, C. M. 1998. Aerial emissions from poultry production. World's Poult. Sci. J., 54:241–251.

Whyte, R.T., 1993. Aerial pollutants and the health of poultry farmers. World's Poult. Sci., 49:139-156.

Willis, W.L., C. Murray and C. Talbott, 1997. Evaluation of leaves as a litter material. Poult. Sci., 76: 1138-1140.

Wyatt, C. L., and T. N., Goodman, 1992. Research note: The utilization of recycled sheetrock (refined gypsum) as a litter material for broiler houses. Poult. Sci., 71:1572-1576.

Table 1. Composition and calculated analysis of the experimental diet

Ingredients	(%)
Yellow corn	60.0
Soybean meal (44%)	19.0
Concentrate	20.0*
Salt	0.25
Minerals mixture	0.25
Premix mixture	0.50
Total	100
Calculated analysis**	
Protein (%)	24.0
ME (Kcal/ Kg)	2900
Crude fiber	2.71
Calcium (%)	1.61
Available phosphorus (%)	0.67

* Broiler concentrate contains: 52% crude protein, 1.6% crude fiber, 6.1% ether extract, 7% calcium, 3.5% available phosphorus , 1.5% methionine, 2.1% methionine and cystine, 3.0% lysine and 2416 kcal/kg metabolizable energy.

Each Kilogram of the broiler concentrate contains the following levels of vitamins and minerals: vit. A 130,000 IU; D3 26,000 IU; vit. E 120 IU; vit B12 150 µg; vit. K3 MSB 16 µg; vit B2 50 µg; capantothenate B3 120 µg; nicotinic acid PP 250 µg ; thiamine B1 25 µg; folic acid 15 µg; pyridoxine B6 15 µg; betain-Choline-HCl 5000 µg; Mn 700 µg;Zn 600 µg; Fe 400 µg;; Cu 40 µg; Iodine 7 µg; Co 2 µg; Se 1.5 µg; B.H.T. 1250 µg; Zinc baciteracin 150 µg.

** Calculated according to NRC (1994).

Table 2. Means ±SE of body weight and body weight gain of local turkeys as affected by litter type

Traits	Age (wks)	Treatments		
		C	T1	T2
Body weight (g)	8	950±9.7	960±12.3	956±8.7
	10	1294±10.7	1295±17.1	1308±15.1
	12	1686±14.0	1665±20.3	1684±18.9
	14	2136±22.4	2110±17.6	2135±14.4
	16	2528±22.8	2490±18.7	2529±14.6
	18	3051±32.5	3012±24.3	3076±19.4
	20	3500±33.8	3449±27.0	3523±24.1
Body weight gain (g/bird/day)	8 - 10	24.5±0.5	23.9±0.7	25.2±0.7
	10 -12	28.8±0.6	26.7±0.5	26.8±0.6
	12 - 14	27.0±2.1	31.8±1.9	32.2± 1.3
	14 - 16	28.0±1.4	27.1±1.4	28.1± 1.4
	16 - 18	37.4±1.8	37.3±1.8	39.1±1.8
	18 - 20	32.4±1.6	31.2±0.9	31.9±0.7
	Overallmean	**29.70±1.9**	**29.70±1.4**	**30.55±1.5**
Feed consumption (g/bird/day)	8 - 10	77.4±3.9	77.2±4.4	77.4±0.6
	10 -12	95.6±0.8	95.9±0.6	97.5±0.5
	12 - 14	118.9±0.8	117.6±0.9	119.8±1.5
	14 - 16	133.4±1.2	130.7±1.5	131.6±0.9
	16 - 18	150.4±1.3	149.6±1.8	152.4±0.3
	18 - 20	169.6±2.6	169.3±3.6	171.6±1.2
	Overallmean	**124.1±1.1**	**125.0±0.89**	**123.4±0.64**
Feed conversion (g feed/g gain)	8 - 10	3.16±0.10	3.23±0.25	3.06±0.04
	10 -12	3.32±0.06	3.60±0.07	3.64±0.11
	12 - 14	4.40±0.19[a]	3.70±0.23[b]	3.72±0.11[b]
	14 - 16	4.75±0.50	4.82±0.12	4.68±0.03
	16 - 18	4.01±0.30	4.02±0.13	3.90±0.05
	18 - 20	5.23±0.27	5.43±0.12	5.38±0.18
	Overallmean	**4.18±0.05**	**4.21±0.06**	**4.04±0.03**

[a and b] Means within each row with different superscripts, are significantly different (P≤0.05).
C, T1 and T2= Birds were raised on wheat straw, clover and corn stalks straw litter, respectively.

Table 3. Means ±SE of carcass traits of local turkeys as affected by litter type

Traits	Treatments		
	C	T1	T2
LBW, g	3725±71.8	3536±173.4	3727±89.8
Carcass,%	72.5±0.57	72.6±0.87	72.5±0.38
Heart, %	0.222±0.00	0.230±0.01	0.221±0.01
Liver, %	2.11±0.04	2.10±0.17	2.03±0.08
Gizzard, %	2.44±0.04	2.47±0.04	2.47±0.03
Abdominal fat, %	2.37±0.16	2.32±0.09	2.28±0.05
Dressed Carcass, %	79.23±0.49	79.4±0.78	80.2±0.36

No significant differences were observed (P>0.05).
C, T1 and T2= Birds were raised on wheat straw, clover and corn stalks straw litter, respectively.

Table 4. Means ±SE of leg problems, breast blisters and mortality rate of local turkeys as affected by litter type

Traits	Treatments		
	C	T1	T2
Foot pad burns score	2.04	1.93	2.57
Hock discoloration score	2.70	2.57	2.93
Breast blisters score	2.03	1.77	2.00
Mortality rate, %	6.66	6.66	8.33

No significant differences were observed (P>0.05).
C, T1 and T2= Birds were raised on wheat straw, clover and corn stalks straw litter, respectively.

Table 5. Means ±SE of litter quality traits for local turkey as affected by litter type

Traits	Period/ age (wks)	Treatments		
		C	T1	T2
Moisture, %	**8**	7.2 ±0.3	6.9 ±0.4	6.6 ±0.5
	12	10.2±0.5	10.1 ±0.6	9.8±0.8
	16	14.4±0.9 [a]	13.6±0.7 [a]	12.2±0.6 [b]
	20	22.4±1.2 [a]	22.3±0.9 [a]	19.2±1.4 [b]
	Overall mean	**13.6±0.9** [a]	**13.2±0.8** [a]	**11.9±1.1** [b]
Litter pH	**8**	5.2 ±0.3	4.9 ±0.2	4.8±0.1
	12	6.2±0.5	6.0 ±0.3	5.9±0.3
	16	7.6 ±0.4	7.2 ±0.3	7.4 ±0.2
	20	9.1 ±1.0	8.9 ±0.9	8.6 ±0.4
	Overall mean	**7.0±0.6**	**6.8±0.5**	**6.7±0.3**
Bacterial count /one gram (10^{-3})	**8**	6.2±1.2	6.0 ±1.1	5.4 ±1.3
	12	9.0 ±0.8	9.0 ±1.0	8.8 ±0.9
	16	16.8 ±4.1	18.89 ±2.9	16.8 ±3.1
	20	32.2 ±3.9	34.2 ±3.6	30.5±5.6
	Overall mean	**16.1±1.8**	**17.0±1.8**	**15.4±2.0**
Caking rate score	**8**	1.0	1.0	1.0
	12	1.50	1.16	1.33
	16	2.00	2.16	1.66
	20	2.83	2.66	2.16
	Overall mean	**1.83**	**1.75**	**1.54**

[a and b] Means within each row with different superscripts, are significantly different (P≤0.05).
C, T1 and T2= Birds were raised on wheat straw, clover and corn stalks straw litter, respectively.

Table 6. Means ±SE of indoors temperature, relative humidity values and airborne quality (ammonia and dust levels) inside the local turkey building as affected by litter type

Traits	Period/ age (wks)	Treatments		
		C	T1	T2
Indoors temperature, C°	**8**	25.8	25.4	25.1
	12	26.8	26.3	26.2
	16	28.7	28.2	28.5
	20	30.5	30.2	29.8
	Overall mean	**28.00**	**27.55**	**27.40**
Relative humidity, %	**8**	54.2	52.8	52.2
	12	53.3	53	52.1
	16	53.4	52.6	51.7
	20	52.8	52.4	52.9
	Overall mean	**53.43**	**52.70**	**52.23**
Ammonia (AM), PPM	**8**	3.9±0.4	4.0±0.3	3.8±0.4
	12	7.4±0.8	7.4±0.7	6.9±0.6
	16	11.0±1.6	11.3±1.2	10.0±1.0
	20	15.8±0.7 [a]	14.6±0.6 [a]	12.8±1.2 [b]
	Overall mean	**9.5±0.6** [a]	**9.3±0.8** [a]	**8.4±0.5** [b]
Dust level (mg/m^3)	**8**	6.2±0.9	6.4 ±1.3	6.0 ±1.6
	12	6.0±1.7	5.9 ±1.0	6.1±0.8
	16	7.6±1.1	7.0±0.7	6.8±1.1
	20	8.0±1.7	7.8±1.3	8.0±1.2
	Overall mean	**7.0±1.2**	**6.8±1.1**	**6.7±1.1**

[a and b] Means within each row with different superscripts, are significantly different (P≤0.05).
C, T1 and T2= Birds were raised on wheat straw, clover and corn stalks straw litter, respectively.

Table 7. Economical efficiency for local turkey as affected by litter type.

Items		Treatments		
		C	T1	T2
Total costs/ bird/L.E	**Litter costs/bird (L.E)**	0.062	0.032	0.026
	Feed costs (L.E/bird)	29.04	29.25	28.88
	Total costs/ bird/L.E	29.00	29.28	28.90
Selling price of live bird at 20 weeks of age (L.E)		61.20	59.74	61.60
Net revenue/ bird/L.E (without *constant costs=25%)		**32,09**	**30,46**	**32,70**
Economical efficiency/bird (EE)		**1,11**	**1,04**	**1,13**
ve economical efficiency/bird (REE)		**100.0**	**94,2**	**102,5**

Cost of 1 kg of carcass weight = 24.00 L.E. Price of 1 kg of ration = 2.6 L.E L.E = Egyptian pound.
C, T1 and T2= Birds were raised on wheat straw, clover and corn stalks straw litter, respectively.
*Constant costs include: housing, labour, heating, cooling, lighting and treatment regimens.

تقييم تبن الربة وسيقان الذرة كمواد فرشه بديلة عن تبن القمح لتربية الرومي المحلى

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اجريت التجربة على عدد ١٨٠ طائر عمر ٨ أسابيع، قسمت الى ثلاثة مجاميع وذلك لدراسة تأثير استخدام كلا من تبن الربة و سيقان الذرة كمواد فرشة بديلة على اداء النمو، صفات الذبيحة، مشاكل الارجل، فقاقيع الصدر، ظروف جو العنبر و الفرشة فى الرومى المحلى. قد ربيت المجموعة الاولي على تبن القمح واعتبرت مجموعة مقارنة (C) ، بينما ربيت المجموعة الثانية والثالثة على فرشة من تبن الربة و سيقان الذرة علي التوالي (المعاملتان T1 ، T2). ولقد ربيت جميع الطيور بالتجربة تحت ظروف بيئية ورعائية متماثلة. أوضحت النتائج عدم وجود اختلافات معنوية بين جميع المعاملات فى وزن الجسم والزيادة فى وزن الجسم، استهلاك العلف وكفاءة التحويل الغذائى، صفات الذبيحة، الاتربة العالقة بجو العنبر، وكذلك الـ pH و عدد البكتريا في الفرشة. بينما كان حدوث مشاكل الارجل وفقاقيع الصدر اقل فى الطيور المرباة على تبن الربة (T1). بالاضافة لما سبق فأن استخدام فرشة تبن سيقان الذرة (T2) قلل من رطوبة وعدد البكتريا بالفرشة، وكذلك تركيز الامونيا في جو العنبر، و هذا ربما ينعكس ايجابيا علي القدرة المناعية، والحالة الصحية للطيور. نخلص من النتائج السابقة والجدوى الاقتصادية الي التوصية باستخدام كلا من تبن الربة و سيقان الذرة كمواد فرشة بديلة لتربية الرومى المحلى.