Comparative study on the nutritional value of some cattle and chicken wastes

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This work was conducted to utilize some of the slaughter wastes and by-products in poultries feed and in man’s food. For this reason the horns and hooves of cattle (cow and buffalo), forestomach contents (of cow and buffalo) and whole blood of cattle and chicken were analyzed. Keratin raw materials were hydrolyzed by different methods and the best method was selected. Isolate protein was also prepared of the horns and hooves mixture. Rumen contents and blood were dried by sun-drying, oven dehydration under vacuum at 70°C and in solar energy ovens. A mixture of NaOH HKM with solar energy oven dehydrated blood and forestomach contents (at 1:1:1 ratio) was used as a fish meal replacer in a test ration for feeding starting chickens up to 8 weeks of age. Moreover, slaughter wastes were used in man’s food, through preparation of broad bean cake (taamia) with P.I. of keratins and by preparation of frying fat blend of bone fat and ghee (samna).The obtained results could be summarized in the following: A. Cattle keratins processing a. Raw keratins1.Differences between horns and hooves of cow and buffalo were extremely slight although differences due to the effect of part or species were significant at 1%, with exception of few cases.2.In general, horns and hooves of cow and buffalo showed the following composition (% on wet and dry weight basis respectively): moisture 5.30-5.74, ; protein 89.96-90.47, 95.11-95.77; fat 2.19-3.10, 2.32-3.27;ash 1.43-1.70, 1.51-1.79; carbohydrates 0.03-0.38, 0.04-0.40; energy value 383.11-388.06, 405.56-406.84 (cal/100 gm).3.Amino acids composition revealed that keratins proteins were deficient in histidine (57.63% of the FAO reference protein), which was not of great importance, because maize (white and yellow varieties) are rich in thisEAA.4.Raw keratins protein were extremely very rich in threonine, methionine +cystine, phenylalanine + tyrosine, leucine, isoleucine, lysine and tryptophan; being therefore a store for EAA; particularly for threonine, lysine, sulphur amino acids and tryptophan lacking in many seeds.5.The absence of advantage, with regard to EAA concentrations of sample or as gm/16 gm N calls for processing of different keratins (horns and hooves of cow and buffalo) as a mixture of all kinds together. This view point might be also confirmed by the narrow range of protein content.b. Hydrolyzed keratin meal (HKM) and protein isolate (PI) of mixtured (KM) keratin (horns and hooves of cow and buffalo)1.Because of drying process, HKM and P.I. had lower moisture contents (4.17 & 3.94% respectively) when compared with the air (naturally) driedKM (5.46%). 2.P.I. contained 88.76% protein, which was somewhat less than for KM (90.09%), because the formed salts had somewhat dilution effect. The ash of KM and P.I. were 1.55 and 6.24% respectively.3. The dilution effect of ash (25.19%) was much greater for HKM on the protein (68.93%) and fat (1.54%) when compared with the P.I. Most offormed salt in the case of P.I. were removed by the weak flow of washingrunning water.4. Due to high protein content the energy value seems to be derived basically from the protein fraction. Therefore the protein and energy were highest for KM (90.09%, 384.56 cal/100 gm respectively), followed by P.I. (88.76%, 363.63 cal/100 gm respectively), while were lowest for the HKM (68.93%, 290.26 cal/100 gm respectively). All difference between treatments were significant at 1% level, except for the carbohydrates of HKM and P.I. 5.P.I. (92.40% protein) and HKM (71.93% protein) might be considered as typical protein isolate (P.I.) and protein concentrate (P.C.), because they contained not less than 90% and 70% (of total solids) crude proteinrespectively. 6.By processing of HKM the amino acids contents decreased a little in the P.I., but such decrease was more pronounced in the

case of HKM.7.Great loss occurred in cystine, which reduced the methionine + cystine content. Methionine decreased, however, was less considerable in HKM.8.Although threonine was pronouncedly decreased in P.I. and HKM, still these two products were extremely rich in this EAA.9.By processing of E.A.A.I., B.V., PER1 and PER2 which were relatively higher in raw materials decreased markedly for HKM and a little for P.I.; values were 86.87, 72.82, 83.56; 82.96, 67.64, 79.35%; 2.46, 2.39, 2.43 and 2.35, 2.24, 2.30 respectively. It is evident that, in spite of the marked loss of EAA, HKM still was of adequate nutritional value.10. HKM was low in NaCI (0.39%); being extremely rich in phosphorus (4.634%). But due to low Ca content (0.032%) suitable measures should be practiced to ensure the recommended Ca:P ratio.B. Blood 1.The time of drying was not affected by the source of blood, while it was varied with the temperature of drying.2.For sun-drying the consumed time for drying was 6 hours (at 34-40°C), while it was 4 hours when using the solar energy method (48-53°C); being lowest (only 3 hours) for oven dehydration at 70°C.3.The yield of meals varied slightly according to the blood source ranging 19.91-21.24%, possibly because of the narrow range of moisture estimated for cow, buffalo and chicken blood (80.7-81.80%). 4.The yield was directly proportion to the level of retained moisture which were 20.16-21.24%, 9.33-9.97%; 20.02-21.12%, 8.80-9.31% and 19.91-21.08, 8.69-8.91% for sun-drying, solar energy and oven dehydrationdrying methods respectively.5.The yield of cow meals (21.08-21.24%) was highest (lowest initial moisture 80.70%), followed by buffalo meals (20.53-20.74%) which showed more initial moisture (81.23%); being lowest for chicken (19.91-20.16%) possibly due to highest initial moisture (81.80%, lowest initial total solids).6.Analysis revealed that the moisture, protein, fat, ash, carbohydrates and energy value of raw blood and dried meals showed the folowing values : 80.70-81.80, 8.69-9.97%; 16.47-17.39, 80.94-85.01%; 0.36-0.68, 0.71-2.26%; 0.71-0.92, 4.11-6.43%; 0.13-0.69, 0.22-0.68% and 72.52-76.10,344.39-350.90 cal/100 gm respectively. Differences between treatments, although were slight, they were mostly significant at 5% level.7.In general, cow blood meals had highest protein, while chicken meals showed highest fat, ash, moisture and mostly highest carbohydrates andenergy.8.Buffalo meals showed lowest fat and ash, chicken meals lowest protein,and cow meals lowest moisture.9.Calculation of A.S. revealed that sun-dried chicken blood protein was the only deficient protein, where isoleucine was 91% of reference protein. This meal showed lowest E.A.A.I. (67.35), B.V. (61.68%) and PER1,2,3 (2.78, 2.93, 3.47 respectively). Dehydration by any method caused the decrease of protein quality as recorded by the decrease of A.S., E.A.A.I., B.V. andPER12,3. 10.The values of E.A.A.I., B.V., PER12,3, revealed that the protein quality was highest for cow products (raw blood and meals prepared by three drying methods), followed by buffalo and was lowest for chicken products. The same values revealed that solar energy method protected the protein quality of blood meals, which showed some deterioration during sun-drying or oven dehydration.11. Solar energy products only B.V. protein as standard), while B.V. oven dehydration methods werewas more than 70% (in relation to egg of other blood meals of sun-drying and less than 70% (with exception of ovendehydrated cow blood meal only) regardless the source of blood.12. EAA concentration of whole blood increased by processing of meal. The protein level and EAA; both were higher for cow, followed by buffalo andlower for chicken blood and meals. Solar energy meals (regardless the source of blood) contained higher levels of EAA (gm/100 gm sample), followed by oven dehydration and sun-drying samples.13.In general, it was found the quality of solar energy meals (particularly that of cow) was the best, when amino acid profile was considered.14.Highest Ca and P were found for the whole blood and meals of buffalo, followed by chicken and cow, regardless of the drying method. Solar energy drying method protected the sample from losses of Ca and P, followed by oven dehydration and sun-drying samples. Therefore, the higher nutritional value (based on Ca and P concentrations) was recorded for solar energy meal, particularly that of buffalo. NaCI was in general too small interfere in any ration formulation. 15.T.B.A. value was higher for chicken whole blood and meals prepared from this raw materials, regardless the method of drying. Solar energy method gave meals with least T.B.A. value increase, followed by sun-drying and oven dehydration method.16.According to the levels of protein, EAA, Ca, P and T.B.A. values, solarenergy meal was the best.C. Rumen contentsRumen contents of cow and buffalo were collected together and dried by sun-drying (average temperature 39°C), vacuum drying (at temperature of 70°C) and in solar energy oven (average temperature 50°C).1. The yield was 12.26-12.64%, showing slight differences which tended toincrease the yield with lowering the drying temperature.2.Vacuum drying at 70°C was less time consuming (3.5 hours) than both sun-drying (at 39°C, for 4 hours) or solar energy drying (at 50°C for 4hours).3.The yield was directly proportional to the moisture content of dried meals being 12.64%, 7.60%; 12.26%, 5.69% and 12.56%, 6.08% for sun-dried, vacuum oven dried and solar energy dried samples respectively.4.Solar energy method resulted in a meal with higher nutritional value due to more retention of total and true protein, followed by vacuum drying oven and finally the sun-dried sample. True protein content was 42.56, 40.98 and 39.81% for the three meals, while total protein was 42.63, 41.03 and 39.86% (WW) respectively. Differences between samples with regard totrue protein content were significant at 1% level.5.The ash seems to be connected with the protein, being significantly highest for solar energy meal (12.30%), followed by vacuum dried(11.83%) and sun-dried (10.95%) meals.6.The increase of nitrogen fractions and ash seems to decrease the fiber and nitrogen free extract (NFE) contents. Thus, highest fiber and NFE were recorded for the sun-dried and vacuum drying oven (18.38-18.86%, 21.31-21.96% respectively); being lowest for the solar energy meal (17.17%, 20.53% respectively). Differences between treatments weresignificant at 1% level.7.The fat was lowest for oven vacuum drying (1.16%), followed by solar energy drying (1.28%) and sun-drying sample (1.47%).8.Energy value was highest for solar energy meal (264.20 cal/100 gm), intermediate for oven vacuum dried sample (262.20 cal/100 gm) while waslowest for the sun-dried sample (257.71 cal/100 gm).9.It seems that the best method of drying was that of solar energy; because the meal of this method showed highest total protein, true protein andenergy value.10.During drying losses occurred in different amino acids of rumen contentsprotein. These losses were extremely high for threonine; being much wore pronounced for sun-dried meal, intermediate for oven dehydration method, and lowest for the solar energy sample as indicated by E.A.A.I., B.V. andPER values.11.It was found that E.A.A.I. and B.V. (which were calculated in relation to egg protein) were above 70 (72-82%), indicating proteins of acceptablequality as compared with the reference protein (egg protein).12.Due to higher protein content the concentrations of EAA (gm/100 gm sample) of the meals were higher than for undried rumen contents. For the same reason solar energy meal showed higher levels of EAA, followed by the oven dehydration sample, which were lowest for the sun-dried meal.13.Ca and P contents were significantly higher for solar energy meal, followed by the sun-dried sample, being lowest for the oven dehydrated rumen contents. This went parallel to the ash levels of different samples.14.Solar energy protected the rumen contents from lipids oxidation, when compared with sun-drying. Oven dehydration meals, were of highest lipids oxidation as indicated by the T.B.A. values. Differences betweentreatments were significant at 1% level.D. Slaughter wastes in chicken nutritioni. When the fish meal replacer composed of equal amounts of slaughterwastes (dried hydrolyzed keratin, dried blood and dried rumen contents) in the test ration replaced 0, 25, 50, 75 and 100% of the fish meal used in the control starter ration, the differences between 100% control ration (0% fish meal replacer) and 100% test ration (control ration with replacerment of 100% of the fish meal with the replacer) was significant at any age.2.The weight of 100% test ration chicken (1907 gm) was higher by 159.3 gm than that of the 100% control ration (1747.7 gm). This means 1.59 ton excess in the weight of 10000 chickens raised on 100% test ration.3.Highest average daily weight gain was found for 100% test ration chickens at any age between 1 and 8 weeks. After 8 weeks, the average daily gain in this treatment (45.14 gm) was significantly higher than any othertreatment (43.81-44.53 gm).4.The average keel bone length was significantly higher and average shank length significantly shorter for chickens of 100% test ration at the end of experiment. This might indicate the more compacted and well build body, with more developed breast muscle. It seems that growth and configuration of chickens (indicated by live weight and daily gain) was connected by the taller keel bone and shorter shank length.5.Mean daily feed consumption increased progressively with advancement of age. For 2-3 and 5-6 weeks of age the feed consumption fluctuated among treatments, while it increased continuously with increasing of test ration proportion for 0-1, 1-2, 3-4 and 4-5 weeks of age. At the end of experiments (6-7 and 7-8 weeks of age), mean daily consumed feed weresignificantly lower for 100% test ration treatment as compared with othertreatment including the control.6. The feed efficiency decreased progressively with advancement of age,particularly beginning with the 4th week. The feed efficiency increased as the proportion of test ration (percent of fish meal replacer) increased; being maximum for 100% test ration treatment, which indicated that the relation between daily gain and consumed feeds was optimum for such atreatment.7. It was found that digestion coefficients for CP, EE, CF, NFE and OM aswell as estimated ME showed close values for different treatments, although differences between treatments were mostly significant. Highest digestion coefficient of CP, EE, and ME were found for 100% test ration.E. Physical composition, carcass traits and meat composition1.It was conclusively indicated that slaughter wastes (used for preparation oftest ration) should be used for feeding starting chickens (as 100% testration) simply because of highest meat as % of live weight (53.06% versus51.40-52.48% for all other treatments including the control).2.The meat plus liver, gizzard and heart (edible offals) was also highest for 100% test ration treatment (58.50% versus 57.17-57.88% for all other treatments). Total edible parts as percent of full and empty carcass were also highest for 100% test ration treatment (65.82 and 89.57% respectively as compared with 62.79-64.41% and 88.89-89.15% for othertreatments respectively).3. Raising on 100% test ration resulted in chickens with highest slaughterweight, carcass weight-full, carcass weight-empty, liver, total edible parts, meat and meat to bone ratio. Released blood and feathers were also highest for the mentioned treatment, which showed lowest weight of some inedible offals, total inedible, bones and bone to meat ratio.4.Percent of gizzard was highest, of heart lowest and of total edible offals intermediate for 100% test ration as compared with other treatments.5.The chemical analysis of whole chicken meat stands by the feeding using 100% test ration. The meat of such sample showed some increase in moisture, while carbohydrates did not change. Moreover, due to the mentioned treatment the protein and ash increased while the fat and accordingly the energy value decreased. When consuming 150 gm of 100% test ration chickens (wet meat) the decrease in percent satisfaction of the daily requirements of adult man in energy was negligible when compared with 100% control ration treatment (8 and 9% respectively), while for protein tangible improvement was found (increased from 51 to54%).6.PWC and PWFC for whole meat increased somewhat due to incorporation of the test ration. As indicated by sensory evaluation the cooked meat of 100% test ration showed negligible decrease in texture score (8 scores) without changing the grade of texture which was rated ”very good” exactly as for the control sample (9 scores). Overall acceptability of all cooked breast and thigh samples of all treatments rated ”very good” (9 scores), indicating that the mentioned practice had no influence on the organolepticqualities of the meat.F. Some economic aspects1.Fish meal replacer was prepared mixing of dried NaOH HKM, solar energy oven dried blood and forestomach contents dried in the solar energy ovenat the ratio 1:1:1.2.The selling price of fish meal replacer, prepared of slaughter wastes was 137.30 Egyptian pound, in contrast to 1960 Egyptian pound for 1 ton of imported herring meal. Therefore the selling price of the replacer was 93%less than that of herring meal.3.Production of fish meal replacer will save hard currency used for importation of the herring meal and at the same time aids in decreasingthe environmental contamination.4.It is noteworthy that when using 100% test ration (prepared using the fish meal replacer instead of the herring meal) no incidence of mortality wereencountered during 8 weeks of chickens feeding.5.As indicated by the average consumed feeds (kg/bird) during the whole feeding experiment, 100% test ration, containing the fish meal replacer seems to stimulate the appetite of chickens.6.Regardless of the higher consumed feeds, the economic efficiency was much greater (2.06) for 100% test ration treatment than found for the 100% control ration chickens (1.63 only); this because of lower. Price of feed, lower total feed cost, higher average live weight, higher total revenue and higher net revenue per bird for 100% test ration as compared with100% control ration treatment.Finally, all experiments and trials stands by the production and use of fishmeal replacer prepared of slaughter wastes.G. Some uses of slaughter wastes for man’s fooda. Broad bean cake (taamia) as prepared with P.I. of K.M.1. it seems that parallel to the increase of P.I. (from 0 to 25%), the nutritionalvalue improved, because of the increase of protein content. Due to this practice G.D.R. value of protein decreased, while P.S./150 increased; also, the fat, ash and carbohydrates decreased while fibers and energy value increased. The increase of P.S.1150 value for energy was very slight while for protein was tangible. The changes of proximate composition due to P.I. incorporation were the same for raw and fried sample, except the decrease of fiber and energy value of the wet sample with increasing ofP.I.2. Due to frying, the moisture content decreased, accordingly protein, fat,ash, fibers, carbohydrates and energy value increased. The consumption of 150 gm of raw taamia will cover 21-26% of the daily requirements of adult man in protein (less than 1/3 the daily needs). After frying, however 150 gm of taamia will cover more than 1/3 the daily requirements of adult man (39-42%). Similarly P.S./150 of energy was about 6% and 13% forraw and fried taamia respectively.3. Amino acids scores of fried taamia protein were all over 1.0, except forhistidine of samples prepared with 20-25% P.I. of keratin mixture; the decrease of A.S. for sample prepared with 15% P.I. was actually negligible (99% of pattern), A.S. was also high (84-90% of FAO) for 20-25% P.I. samples; up to 10% P.I. no deficiency in any of the EAA was observed.4. Regardless the small decrease of histidine, the E.A.A.I., B.V. and PERwere higher for P.I. taamia, including the sample prepared with 25% P.I.,161due to higher concentrations of isoleucine, leucine, valine, methionine + cystine, threonine and tryptophan than the P.I. free sample (control). This indicated the higher nutritional value of 10-25% P.I. taamia. B.V. of all P.I. samples protein were higher than 70% of egg protein indicating the high quality protein of P.I. taamia, B.V. of control sample was less than 70% of egg (64%).5. The R.A. for the control sample was methionine + cystine, while that of P.I.taamia was the histidine. Even for 25% P.I. taamia P.S./150 for R.A. was 36%, i.e. higher that 1/3 the daily requirements of man, which is enough for one meal. This confirmed the high nutritional value of P.I. taamia.6.Cooking yield increased (from 84.18 to 91.7%), while cooking loss decreased (from 15.82 to 8.30%) as the percent of P.I. in taamia increased from 0 to 25%.7.Sensory evaluation indicated that control and P.I. samples of taamia rated”very good” (average score 8-9) regardless the level of P.I. Nevertheless itis recommended to use protein isolate at not more 15% level, to avoid thechange of inner parts colour of fried taamia and the considerabledeterioration of taste (at 20-25% P.I. levels). The texture of taamiadecreased by addition of P.I. as indicated by the increase of PWC andPWFC. Nevertheless this decrease was slight as judged by organolepticttest. Any way addition of 15% P.I. resulted in good quality fried taamia,when the palatability was considered.b. Frying fat as prepared by blending bone fat with ghee (samna or melted milk butter)1. Sensory evaluation of fried potatoes, revealed that 75% ghee + 25% bone fat (of beef femur) was selected as the best blend with maximum possible bone fat. This because overall acceptability for blends with 0 to 25% bone fat rated very good ”8-9 scores”, while for 30% bone fat and more blendsoverall acceptability of potatoes decreased remarkably.2. The smoke point was determined because frying fat should have smokepoint of not less the 228°C. It was found that smoke points of bone fat was low (230°C) as compared with ghee (260°C) but both were higher than 228°C. As the proportion of ghee increased in the blends, the smoke pointand stability of frying fat increased.3. For selected organoleptically blend (25% bone fat) the smoke point(243°C) was far away from above threshold (228°), while for 100% bone fat the smoke point was near (230°C) the mentioned threshold (228°C)given for good quality frying fats.4. Ghee was characterized by the presence of low molecular weight FA(04 0, 06:0, 08.0 and Ciao), which decreased in ghee-bone fat blends as the percent of bone fat increased. Ghee contained C1210 which was not found in bone fat; the latter contained C141, 01710 and C17:1, absent in ghee. Moreover, ghee was a saturated fat (T.Sat. FA 73.65%, T. Unsat. FA 26.35%), while bone fat was unsaturated (T.Sat.FA 29.85%, T.Unsat.FA 70.15%).5. Incorporation of ghee with bone fat might possibly increase the stability ofbone fat due to the decrease of unsaturation and increase of saturation. T.Sat.FA and T.UnSat.FA of pure bone fat and 25% bone fat blend were 29.85, 62.69 and 70.15, 37.31% respectively. It seems that 25% bone fat (plus 75% ghee) blend will survive heating during frying of foods more thatthe pure bone fat do.6. Blending of bone fat with ghee improved the nutritional value of the latter due to the increase of essential fatty acids (EFA, linoleic plus linolenic) from 2.95% in ghee to 2.98% in 75% ghee + 25% bone fat treatments.