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Utilization of Poultry Processing By-Products

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This study was conducted to prepare pasteurized duck and chicken liver paste by adding some natural additives (rosemary, cardamom and liquid smoke) with 0.5 and 1.0% and stored at 4±1ºC for 25 days. Chicken burger which prepared by replacing minced chicken with 20, 40 and 60% of gizzard or mechanical deboned meat (MDM) and stored at -18°C for 6 months. Chemical composition, chemical and physical quality characteristics, microbiological evaluation and sensory properties of these prepared products were evaluated.

The obtained results can be summarized as follows:

6.1. Total phenolic, total flavonoids and antioxidant activity of (rosemary, cardamom and liquid smoke):

Results showed that rosemary had significantly ($p \leq 0.05$) higher total phenolic and total flavonoids compounds (61.27 mg gallic acid/g dried sample and 19.81 mg rutin/g dried sample, respectively) than cardamom (26.70 gallic acid/g and 12.62 mg rutin/g dried sample, respectively) and liquid smoke (15.48mg/ml and 3.68 mg rutin /ml, respectively). The highest DPPH free radical scavenging activity

(98.08 %) was recorded for rosemary followed by cardamom (88.46%) and finally liquid smoke (67.91%).

6.2. Quantification of individual phenolic compounds of (rosemary, cardamom and liquid smoke):

Results indicated that twenty five phenolic compounds were identified in each one, but the amount of these compounds was different according to the type of additive. Liquid smoke had the lowest quantity of these identified compounds (509.68 ppm) when compared with rosemary (21173.96 ppm) and cardamom (1678.31ppm). The most abundant phenolic compounds in rosemary were Ellagic, E-vanillic, carnosic, rosmanol and benzoic acid. E-vanillic, pyrogallol, ellagic, salycilic and catechol were the most abundant phenolic compounds in cardamom. While, the most abundant phenolic compounds in liquid smoke were Ellagic, e-vanillic, pyrogallol, salycilic, chlorogenic, benzoic, p- coumaric and 3,4,5-methoxycinnamic.

6.3. Quantification of individual flavonoids compounds of (rosemary, cardamom and liquid smoke):

Results indicated that eleven flavonoid compounds were identified in each additive, but the amount of these compounds was different according to the type of additives rosemary had the highest quantity of flavonoid compounds (1135.97 ppm) when compared with cardamom (413.96 ppm) and liquid smoke (212.48 ppm). Hesperidine was the major flavonoid compound in all additives followed by naringin, rutin and quercetrin.

6.4. Duck and chicken liver pastes:

6.4.1. Proximate composition and microbial load of duck and chicken liver:

Results cleared that the duck liver had significantly ($p \leq 0.05$) higher moisture and lower ($p \leq 0.05$) crude protein, crude fat and total ash than chicken liver. Moreover, there were no significantly ($p > 0.05$) differences in carbohydrates content between duck liver (0.94%) and chicken liver (0.82%). Total bacterial counts of duck and chicken liver were 1.78×10^2 and 4.49×10^2 *cfu/g* and spore forming bacteria were 1.56×10^2 and 2.25×10^2 *cfu/g*. Duck and chicken livers were completely free from *staphylococcus aureas, clostridium Sp.* and yeast and mold.

6.4.2. Proximate composition of liver pastes:

The duck liver paste had higher ($p \leq 0.05$) moisture and total carbohydrates contents and lower ($p \leq 0.05$) crude protein, crude fat and total ash contents than chicken liver paste. Liquid smoke liver paste had higher ($p \leq 0.05$) moisture content and the lower ($p \leq 0.05$) total ash and total carbohydrate contents than those formulated with rosemary and cardamom. Control liver paste had higher ($p \leq 0.05$) crude fat content and lower ($p \leq 0.05$) total ash and total carbohydrate contents than those formulated levels of additive. The moisture, crude protein, crude fat, total ash and total carbohydrate contents were not significantly ($p > 0.05$) affected during the storage period.

6.4.3. Fatty acids composition:

Total saturated and mono unsaturated fatty acids of different duck and chicken liver pastes were decreased slightly by addition 0.5 and 1.0% of different additives. The predominate saturated fatty acids of all liver pastes were palmitic acid (C16:0) and stearic acid (C18:0). The predominate mono unsaturated fatty acids of all liver pastes were oleic acid (C18:1). The predominate poly unsaturated fatty acids of all liver pastes were linoleic acid (C18:2). Total SFA of all liver pastes were slightly increased by advancement of storage period while, total MUSFA and PUSFA were slightly decreased by advancement of storage period.

6.4.4. Amino acids composition:

Total essential and non-essential amino acids of different duck and chicken liver pastes were decreased slightly by addition 0.5 and 1.0% of different additives. The predominate essential amino acids of all liver pastes were leucine and lysine and the predominate non-essential amino acids were glutamic, aspartic and proline. Total essential and non-essential amino acids of all liver pastes were slightly decreased by advancement of storage period.

6.4.5. Chemical quality characteristics and pH value:

Chicken liver paste had significantly higher ($p \leq 0.05$) TVN, TBA, PV and AV values than duck liver paste. The liver paste formulated with rosemary had lower ($p \leq 0.05$) TVN, TBA, PV and AV values than those formulated with cardamom and liquid smoke. Control liver paste had higher ($p \leq 0.05$) TVN, TBA, PV and AV values than liver paste formulated with different levels additives. The pH values of all liver pastes were not affected ($p < 0.05$) by the type of liver, type of additives, level of additives and the storage period. The TVN, TBA, PV and AV values of the liver pastes were significantly ($p \leq 0.05$) increased as the storage period increased.

6.4.6. Microbiological analysis:

The duck liver pastes had lower total bacterial and spore forming bacteria than chicken liver pastes. Liver pastes prepared with different types of additives had lower microbial loads than control liver pastes. The liver pastes formulated with different levels of rosemary had lower total bacterial and spore forming bacteria counts than other additives. These microbial loads were decreased by increasing the levels of the additives from 0.5 to 1.0%. The total bacterial counts and spore forming bacteria of all liver pastes were increased by increasing the storage period. *Staphylococcus aureus, Clostridium sp.* and yeast and mold were not detected in all liver pastes during the storage period.

6.4.7. Sensory properties:

The sensory properties of duck liver paste had higher ($p \leq 0.05$) scores of taste, odor, color, texture and overall acceptability than chicken liver paste. The liver paste formulated with liquid smoke had significantly higher ($p \leq 0.05$) color and texture scores and the lower ($p \leq 0.05$) taste and odor scores than those formulated with rosemary and cardamom The liver pastes formulated with 1.0% level of additives had significantly higher ($p \leq 0.05$) taste and odor scores and lower ($p \leq 0.05$) color and texture scores than control and those formulated with 0.5% level of additives. The sensory properties of the liver pastes were decreased ($p \leq 0.05$) by increasing the storage period.

6.5. Chicken burger:

6.5.1. Proximate composition of and microbial load of raw chicken meat, gizzard and mechanical deboned chicken meat (MDCM):

The chicken meat had ($p \leq 0.05$) higher crude protein and total ash than chicken gizzard and MDCM. The MDCM had ($p \leq 0.05$) higher crude fat and lower ($p \leq 0.05$) moisture, crude protein and total ash contents than chicken meat and gizzard. The MDCM had higher total bacterial count, psychrophilic bacteria and *staphylococcus aureas* than chicken meat and gizzard. Chicken meat, gizzard and MDCM were completely free from *Salmonella spp* and yeast and mold.

6.5.2. Proximate composition of different chicken burger:

Chicken burger formulated with gizzard had higher ($p \leq 0.05$) moisture, crude protein and total ash and lower ($p \leq 0.05$) crude fat than chicken burger formulated with MDCM. The total carbohydrates content was similar ($p > 0.05$) in the chicken burgers formulated with gizzard or MDCM. The control chicken burger had higher ($p \leq 0.05$) crude protein and total ash contents and lower ($p \leq 0.05$) crude fat content than chicken burger formulated with different levels of gizzard and MDCM. The Non-significant ($p > 0.05$) differences were observed in moisture and total carbohydrate contents among all burger. The moisture content of the chicken burger was ($p \leq 0.05$) gradually decreased by increasing the storage period. However, total carbohydrates content had an opposite trend. The crude protein, crude fat and total ash contents were not affected by the storage period.

6.5.3. Amino acids composition of different chicken burger:

Total essential and non- essential amino acids of different chicken burger treatments were slightly decreased by replacement of chicken meat with of gizzard and MDM. The predominate essential amino acids of all chicken burger were leucine, lysine and valine. The predominate non-essential amino acids were glutamic, aspartic, alanine and glycine. Total essential and non-essential amino acids of all chicken burger were slightly decreased by advancement of storage period.

6.5.4. Chemical quality attributes of different chicken burger:

Chicken burger formulated with MDCM had significantly higher ($p \leq 0.05$) TVN, TBA and PV values than chicken burger formulated with a gizzard. The TVN and TBA values were increased by increasing the levels of gizzard and MDCM. However, PV values were not affected ($p > 0.05$) by the levels of gizzard and MDCM. The TVN, TBA and PV values of the chicken burger were significantly ($p \leq 0.05$) increased as the storage period increased.

6.5.5. Physical properties of different chicken burger:

Chicken burger formulated with MDCM had significantly higher ($p \leq 0.05$) pH, and plasticity values and lower ($p \leq 0.05$) WHC and drip loss than chicken burger formulated with a gizzard. Control chicken burger had lower ($p \leq 0.05$) pH and plasticity values and higher ($p \leq 0.05$) drip loss than chicken burgers formulated with different levels of gizzard and MDCM. A non-significant difference ($p > 0.05$) was observed in WHC between the control and other chicken burgers. The WHC and drip loss values were increased ($p \leq 0.05$) and plasticity decreased ($p \leq 0.05$) by increasing the storage period.

6.5.6. Cooking properties of different chicken burger:

Chicken burger formulated with gizzard had significantly higher ($p \leq 0.05$) cooking loss and shrinkage than chicken burger formulated with a MDCM. Control chicken burger had lower ($p \leq 0.05$) cooking loss and higher ($p \leq 0.05$) shrinkage than chicken burgers formulated with different levels of gizzard and MDCM. The cooking loss and shrinkage were increased ($p \leq 0.05$) by increasing the storage period.

6.2.7. Microbiological analysis:

The chicken burgers formulated with different levels of gizzard had lower total bacterial, psychrophilic bacteria and *Staphylococcus aureus* counts than control chicken burger. However, the chicken burgers formulated with different levels of MDCM had higher total bacterial, psychrophilic bacteria and *Staphylococcus aureus* counts than control chicken burger. *Salmonella Spp* and yeast and mold were not detected in all chicken burgers during the storage period.

6.2.9. Sensory properties:

The sensory properties of chicken burgers formulated with gizzard had higher ($p \leq 0.05$) scores of taste, odor, color, texture and overall acceptability than chicken burger formulated with MDCM. The Control chicken burger had significantly higher ($p \leq 0.05$) odor and color scores than chicken burgers formulated with different levels of gizzard and MDCM. Generally, the chicken burger could be formulated up to 60% gizzard and MDCM with acceptable sensory properties. The sensory properties of the chicken burgers were decreased ($p \leq 0.05$) by increasing the storage period.