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Utilization of processed animal byproducts as a raw material to develop shelf-stable and cost effective pet food

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Abstract

The demand for pet food is increasing at a robust pace due to the gaining momentum and increasing pet population. The rising cost of commercial pet food has become a matter of concern. Therefore it is the need of hour to develop cost effective along with quality nutritive pet food, which can be achieved by utilization of various animal by-products. It has been proclaimed that slaughter house by-products are traditionally being fed to animals and pets. Various by-products have been attempted in different type of pet foods and feeding other animals besides pet dogs, since these by-products are rich in protein, fats, vitamins and minerals. Therefore this review reflects the use of various processed by-products in pet food products with respect to their nutritive and functional properties.

Keywords: Pet food, by-products and cost effective

1. Introduction

The registered pet dog population has recorded a magnificent growth and still found to be increasing worldwide. According to Statistic report, there are 471 million pet dogs worldwide in 2018. According to industry estimates, at present there are over 31 million pets in India, with a growth rate of approximately 11%, implying an addition of almost 3 million pets per year. The ever increasing pet dog population and increase in its adoption is mainly due to steady rise in nuclear family, rapid urbanization, increasing theft, need for a companionship and rapid increase in pet humanization. Now-a-days pet dogs are treated not less than a member of their family and due cares are given with regards to their diet, health and well-beings. The concept of per owner has now changed to the term 'pet parents'. The pet food market in terms of pet type has been segmented into dog food, cat food, and others. The dog food segment holds the largest market share in pet food market in India. Pet food industry is gaining momentum at a robust pace around the world, mainly due to better economy of the per owners, increasing urbanization, influence of media and awareness of the owners about nutritionally balanced pet food. Since last two decades pet owners are started shifting from conventional feeding of home food to commercially prepared pet foods, which are generally perceived to be more nutritious, convenience and more palatable. Moreover home-made pet foods are often crudely balanced and are mostly deficient in protein, energy, calcium, phosphorus, vitamins and micro-minerals moreover they may not achieve satisfactory palatability, digestibility or safety as required for a dog (Pattanaik, 2011) [30]. As per Statista Market report the global market revenue in the pet food segment amounts to US\$147.30 bn in 2023, and the market is expected to grow annually by 11.11% (CAGR 2023-2027). As per Indian Market Research Report, Indian dog food market size reached US\$ 2.4 bn in 2022 and is expected to reach US\$ 3.5 bn by 2028, exhibiting a growth rate (CAGR) of 6.1% during 2023-2028. Though the demand for pet food is increasing at a robust phase, there is much concern among pet owners with regards to rising cost and quality of pet food available in the market. Many studies and reports have already described on the uses of animal by-products as pet food, fish and poultry feeds. However the Indian pet food industry is more of cereals based and less based on animal by-products. This result in pet's competing with humans for grains and cereals which can be easily replaced by slaughter house by-products.

Therefore, with this review an attempt has been made to focus on research work and highlights the potentiality and substitution of processed animal by-products like meat-cum-bone meal, rendered fat, blood meal and gelatine in preparation commercial pet food, thereby reducing the environment pollution results from animal slaughter house wastes and increasing profit from per unit animal.

1.1 Pet food and its different types

The term 'Pet food' simply means commercially available animal feeds intended for consumption by pets, usually specific to the type of animal, such as dog food or cat food. However, the overall pet food industry also caters to other species like birds, fish, reptiles and rodents besides cats and dogs (Miller, 1996; Boermans and Leung, 2007) [25, 4]. Depending upon the processing methods applied, ingredients used and moisture content in the pet food, it may be broadly classified into dry type, semi moist type and moist type (Case *et al.*, 1998) [7]. Harlow (1997) [15] classified pet foods based on ingredients used, cost of production and overall quality such as premium and super-premium, basic nutrition and economy, vegetarian, homemade, and therapeutic (veterinary) diets. As per National Research Council (2006) [26] dry type pet food should contain moisture 6-10 per cent, fat 7-20 per cent, protein 16-30 per cent, carbohydrate 41-70 per cent and energy 2800-4050 Kcal ME/kg feed. The moisture content of semi-moist pet foods has an intermediate water content of 25-35 per cent and a moist food varies from 60 to more than 87 per cent.

1.2 Pet food ingredients

Carbohydrates form the major energy containing components of plants. Besides being energy supplement they also helps in proper gastrointestinal tract functioning. Carbohydrate ingredients improve the physical characteristics for effective processing of pet foods. A soft crumb dry pet food can be prepared by mixing ingredients with high starch content or cereals grain and flavor ingredients like meat scrap, hydrolyzed protein and other fibrous ingredients. (Miller and Hansen, 1975) [24]. Funaba *et al.* (2002) [13] stated that dry type commercial pet food usually contains good amount of cereal ingredients, because of their lower cost and it can be used as a source of starch during processing by extrusion process. Protein in the diet provides both essential and non-essential amino acids. Protein ingredients contain more than 20 per cent protein. The palatability and acceptability is enhanced by them. Canine species like dog prefer animal tissues to vegetables in food; therefore it is advantageous to add an animal protein source to the formulation. Protein ingredients also provide structural integrity to food. Fat is another important component pet food. They supply the essential fatty acids (EFAs), which helps in maintaining structural integrity of cell membranes and also plays a vital role in maintaining normal skin structure and function. Fat ingredients commonly used are animal fats (lard, tallow, poultry fat) and various types of vegetable oils (soybean, sunflower and corn) etc. Fat ingredients are extremely efficient in delivering energy, flavour enhancement and they serve as carriers for fat-soluble vitamins. Contribution of energy (calorie) by fat is 2.25 times higher than that contributed by either carbohydrates or protein. Rendered fat and oil like tallow, lard, and poultry fats provide a supplementary energy source, improves flavour, texture and nutrients quality in pet foods (Aldrich *et al.*, 2006) [2].

1.3 Practical importance of processed animal by-products (rendered ingredients)

Meat by-products are produced by slaughterhouses, meat processors, wholesalers and rendering plants, however processed animal by-products may include secondary by-products like meat-cum-bone meal, rendered fat, blood meal, bone meal, blood meal and gelatine. Meat-cum-bone meal (MCBM) is composed of meat residues, organ meat, bone, associated fat and to some extent, hair and blood. There is no fixed ratio among these components used by manufacturers; hence the resulting products may vary in chemical composition and nutritive quality (Sibbald, 1986) [40]. Generally MCBM contains more than 55% protein, moisture 3-5% and phosphorous more than 4.5%. Meat meal (Protein more than 55%, moisture 7%, crude fat 8% and phosphorous 4.5%), Bone meal (Protein 7%, calcium 32.5%, phosphorous 15% and moisture 7%) and Blood meal (Protein more than 80% ad moisture 10-12%) respectively. Tallow has shown benefit to "olfactory acuity scores". Tallow requires less antioxidant to achieve shelf stability as it is more stable compare to other less saturated fat. Tallow also acts as a potent natural element to fight against cancer due to presence of conjugated linoleic acid (Altom *et al.*, 2003) [3]. The owner's preference, physical attributes (odour, colour and appearance) and palatability attributes by dogs towards the pet food was extremely enhanced by incorporation of MCBM and rendered fat (Dust *et al.*, 2005, Karthik, 2007 and Pame *et al.*, 2016) [10, 17, 28]. The texture profile (hardness, fracturability and gumminess) significantly reduced with addition of MCBM and rendered fat when compared with control (without MCBM and rendered fat). The addition of rendered fat results in weaker solid matrix due to lesser interaction of the fat with other ingredients and higher water binding by addition of MCBM (Pame *et al.*, 2016) [28]. The fat generally modifies the textural characteristics by interacting with the other ingredients of the food to develop a soft and smooth mouth feel (Giese, 1996) [14]. Addition of slaughter house by-products in the form of rendered fat, MCBM and blood meal significantly increase the protein, fat and ash per cent in the pet foods (Urling *et al.*, 1993 and Rana Raj, 2006) [42, 37]. MCBM contains approximately 50 per cent protein and a good source of animal-based protein and can be used to improve the nutritional quality of pet foods (Parsons *et al.*, 1997) [29]. Traditionally by-products from animal slaughter house have served as rich source of protein, mineral and many vitamins for all the pet animals (Regland *et al.*, 1998) [39]. Utilization of blood and plasma protein as high quality ingredients in farm animal feed and pet food is significantly increasing due to their nutritional and health benefits (Drepper and Drepper, 1979; Cozzi *et al.*, 1995; Ockerman and Hansen, 2000; Lawrence *et al.*, 2004; Polo *et al.*, 2004) [9, 8, 27, 20, 34]. Spray-dried blood plasma significantly enhance the texture by improving cohesion between the different ingredients in the recipe due to its excellent water binding and emulsifying capacity, when used in loaf, chunk, and pouch type pet foods. Besides increase in palatability, it is also highly preferred by carnivores like cats and dogs (Polo *et al.*, 2005; Polo *et al.*, 2007) [35-36].

1.4 Processed animal by-products (rendered ingredients); safety concern and its influence on pet food

Rendering is one of the earliest forms of recycling and it is one of the best methods for processing slaughter house by-products for preparation of processed/secondary by-products.

The primary product resulting from the rendering process is meat cum bone meal and rendered fats. (Meeker and Hamilton, 2006) [22]. As per Persmers and Toregrand (1971) [32] copper and iron are the strongest and notable pro-oxidants present in rendered materials. They produce apparent oxidative effect even at low concentrations of 0.005 and 0.03 ppm respectively (Marfec and Bulinski, 1997) [21]. Rendering process is carried out for an average of 40 min or more at temperatures range between 115 to 146 °C which results in the destruction of most of the pathogenic bacteria (Troutt *et al.*, 2001) [41]. Without rendering, unprocessed animal by-products will accumulate there by increasing the cost of disposal and pose a serious potential hazard to animal and human health. Use as feed ingredients is the most important and valuable use of animal by-products (Meeker and Hamilton 2006) [22]. Rana Raj (2006) [37] studied the effect of irradiation on dog biscuits developed using meat-cum-bone meal, bovine blood and rendered fat and observed that dog biscuits containing 10% moisture level and irradiated at 4 KGy had better keeping quality of more than 180 days. The use of processed whole blood and blood-derived proteins as ingredients in animal feed and human food chain poses only a minimal food safety threat in terms transmission of transmissible spongiform encephalopathy and exposure to blood allergens and blood-borne pathogens (Jack A., *et al.*, 2014) [16]. So far transmissions of prion particles were detected in blood only when the animals had been exposed to the infectious agent through transfusion or intracerebral route. PrPsc have not been detected in any of blood samples, where animals were exposed orally to the infectious agent (Middleton and Barlow, 1993; Wells *et al.*, 1998; Brown *et al.*, 2000; Espinosa *et al.*, 2007) [23, 43, 6, 12].

1.5 Market potential and opportunities

Kartik *et al.*, (2010) [18] prepared pet food (whole meal) with good nutritive quality and palatability for dogs incorporating 10-20 per cent spent hen meal which can be stored safely up to 45 days at room temperature. Pet food with good acceptability to dogs was prepared by incorporation of 35% poultry by-product meal *viz.* chicken head and feet and 10% cruciferous vegetable by-product meal using minimum low cost equipment and simple easily adoptable technique with Rs.70/kg as cost of production against the present cost of commercially available pet food (whole meal) as Rs. 160 to 550/kg., thereby exhibiting its good market potential (Brindha, N. and Rao, V.A. 2017) [5]. Pame, K. *et al.*, (2016) [28] developed dry type pet kibble by incorporation of meat-cum-bone meal at 20 per cent and rendered fat at 5 per cent levels which enhanced over all palatability attributes, intake ratio, improved owners preferences. The nutritional profiles were in line with AAFCO, 2007 recommendation for adult dogs for maintenance purpose. The developed pet kibbles were highly acceptable even on 60th days of storage at room temperature with a cost of production of 170/kg. Rani *et al.* (2011) [38] obtained lower cost of production and observed higher palatability on dogs and better owner's preference besides improvement in odour, colour and appearance on shelf stable pet food prepared by incorporating MCBM and ghee residue. The inclusion of tripe powder at 5 per cent level significantly improved the intake and nutrient qualities of the pet pasta with a cost of production of Rs 153.46/kg, which is an indication of good market potential (Yazhinidevi., *et al.*, 2022) [44]. Poultry protein meals contain high quality protein and popularly used in pet food. The pet food industry used about 23 per cent of the rendered poultry meal produced every

year (Pearl 2003) [31]. The melting point and fatty acid composition of fat are an important factor for the production of a high quality feed pellet. A firm pellet leads to higher production. Feeding animal fat reduce feed costs, improves feed performance and result in higher return on animal by-products. (Petz, 2003) [33]. Kerasote (2013) [19] stated that 'Without rendering process and allied industries, there would be no modern meat industry, because the leftovers of slaughterhouses would inundate landfills and create an enormous health hazard, as billion tons of organic waste rotted. Instead, rendering process recycles these wastes into valuable products'. The use of rendered component as source of phosphorus in pet foods plays an important role in sustainability of pet food industry, because phosphate rock is non-renewable source and is running out worldwide (Edwards, 2013) [11].

2. Conclusion

Utilization of processed animal by-products in the form of MCBM, rendered fat, and processed blood offers highly nutritious, enhanced over all palatability attributes, improved owners preferences and lower the cost of production. Thus pet food manufacturing has good potential to capture market as these pet foods are convenience and highly acceptable by both pets and pet owners and may create self-employment opportunities for youths. Utilization of animal by-products for the preparation of pet food will also alleviates the environmental pollution problems besides gaining better return per unit animals.

3. Reference

1. AAFCO, Nutrient requirement for cats and dogs. AAFCO Official Publications; c2007. p. 25.
2. Aldrich G. Rendered products in pet food. Essential rendering all about the animal by- products industry. National renderers association, Kirby Lithographic Co., Inc. Arlington, Virginia, www.renderers.org, accessed on 20.1.2007; c2006. p. 158-177.
3. Altom EK, Davenport GM, Myers LJ, Cummins KJ. Effect of dietary fat source and exercise on odorant-detecting ability of canine athletes. *Research in Veterinary Science.* 2003;75:149-155.
4. Boermans HJ, Leung MCK. Mycotoxins and the pet food industry: toxicological evidence and risk assessment. *International Journal of Food Microbiology.* 2007;119:95-102.
5. Brindha N, Rao VA. Cost effective utilization of Poultry and Cruciferous Vegetable Waste as a Raw Material to Develop a Shelf-stable Pet Food. *Journal of Animal Research and Nutrition.* 2017;2:7.
6. Brown P. BSE and transmission through blood. *Lancet.* 2000;356(9234):955-956.
7. Case LP, Daristotle L, Hayek MG, Raasch MF. Canine and feline nutrition. (1st Ed.) Mosby Elsevier, 3251 Riverport Lane, Maryland Height, Missouri; c1998. p. 163.
8. Cozzi G, Andrighetto I, Berzaghi P, Andreoli D. Feather and blood meal as partial replacer of soybean-meal in protein supplements for sheep. *Small Ruminant Research.* 1995;15(3):239-245.
9. Drepper G, Drepper K. Method of manufacturing new protein products from animal blood for use in food and feed. *Fleischwirtschaft.* 1979;59(9):1252-1257.
10. Dust JM, Grieshop CM, Parsons CM, Karr-Lilienthal LK, Schasteen CS, Quigley JD, *et al.* Chemical composition,

- protein quality, palatability, and digestibility of alternative protein sources for dogs. *Journal of Animal Science*. 2005;83:2414-2422.
11. Edwards AC. Utilizing rendered products as part of the responsible management of world feed resources. In: *Proceedings of the XIIth International Symposium, Rendering for Sustainability*, Melbourne, Australia. Australian Renderers Association, Melbourne, Australia; c2013. p. 11-17.
 12. Espinosa JC, Morales M, Castilla J, Rogers M, Torres JM. Progression of prion infectivity in asymptomatic cattle after oral bovine spongiform encephalopathy challenge. *Journal of General Virology*. 2007;88:1379-1383.
 13. Funaba MM, Matsumoto C, Matsuki K, Gotoh K, Kaneko M, Iriki T, *et al.* Comparison of maize gluten meal and meat meal as protein source in dry foods formulated for cats. *Journal of Veterinary Research*. 2002;63:1247-1251.
 14. Giese J. Fats and fat replacers; balancing the health benefits. *Food Technology*. 1996;50(9):76-78.
 15. Harlow J. US pet foods trends. In *proceedings of the petfood forum*, Chicago, Watts Publishings; c1997.
 16. Ofori JA, Yun-Hwa PH. Issues Related to the Use of Blood in Food and Animal Feed. *Critical Reviews in Food Science and Nutrition*. 2014;54(5):687-697, DOI: 10.1080/10408398.2011.605229.
 17. Karthik P. In studies on the preparation of spent hen meal and its utilization in pet dogs. M. V. Sc., Thesis, Tamil Nadu Veterinary and Animal Sciences University, Chennai, India; c2007.
 18. Karthik P, Kulkarni VV, Sivakumar K. Preparation, storage stability and palatability of spent hen meal based pet food. *Journal of Food Science*. 2010;47(3):330-334.
 19. Kerasote T. Pukka's promise: The quest for longer-lived dogs. Houghton Mifflin Harcourt, New York, NY; c2013. p. 194-203.
 20. Lawrence KR, Goodband RD, Tokach MD, Dritz SS, Nelssen JL, Derouchey JM. Comparison of wheat gluten and spray-dried animal plasma in diets for nursery pigs. *Journal of Animal Science*. 2004;82(12):3635-3645.
 21. Marfec A, Bulinski R. Content of some trace elements in nuts and edible seeds. *Bromatologia i Chemia Toksykologiczna*. 1997;30:125-128.
 22. Meeker DL, Hamilton CR. An overview of the rendering industry. In: D. L. Meeker, editor, *Essential rendering*. National Renderers Association, Alexandria, VA; c2006. p. 1-16.
 23. Middleton DJ, Barlow RM. Failure to transmit bovine spongiform encephalopathy to mice by feeding them with extraneural tissues of affected cattle. *Veterinary Record*. 1993;32(22):545-547.
 24. Miller TA, Hansen CJ. US Patent 3 908 025, Washington DC; c1975
 25. Miller T. Utilizing rendered products: Pet Food. Ch. 10. *The Original Recyclers*. D A. Franco and W. Swanson, (Ed.). The Animal Protein Producers Industry; c1996. p. 203.
 26. NRC. The Nutrient requirement of dogs and cats. National Research Council. National Academic Press, Washington, D.C. USA; c2006.
 27. Ockerman HW, Hansen CL. Blood utilization. In: *Animal by-product Processing and Utilization*. Technomic Publishing Company Inc., Lancaster; c2000. p. 325-353.
 28. Pame K. Development of pet kibbles using processed animal by-products. Master of Veterinary Science., Thesis, Kerala Veterinary and Animal Sciences University, Pookode, India; c2016.
 29. Parsons CM, Castanon F, Han Y. Protein and amino acid quality of meat and bone meal. *The Journal of Poultry Science*. 1997;6:361-368.
 30. Pattanaik AK. Evaluation and optimization of the nutritional quality of home-made vegetarian foods for health and well-being of dogs- Final Report. Indian Veterinary Research Institute, Izatnagar, India; c2011.
 31. Pearl G. President, Fats and Protein Research Foundation, Personal communication; c2003.
 32. Persmers U, Toregrand B. Metal analysis of edible fats and oil by atomic absorption spectroscopy. *Journal of the American Oil Chemists' Society*. 1971;48:650-652.
 33. Petz E. Dutch Meat Board. Der inhalt des Futtertroges ist entscheidend. *Pro Mont Fleisch*. 2003;18:6-7.
 34. Polo J, Saborido N, Rodenas J, Rodriguez C. Determination of the presence of bovine immunoglobulin G in liquid or spray-dried porcine plasma and whole blood by agar gel immune diffusion. *Journal of Association of Official Analytical Collaboration International*. 2004;87(1):78-82.
 35. Polo J, Rodriguez C, Saborido N, Rodenas J. Functional properties of spray-dried animal plasma in canned petfood. *Animal Feed Science and Technology*. 2005;122(3-4):331-343.
 36. Polo J, Rodriguez C, Rodenas J, Morera S, Saborido N. Use of spray-dried animal plasma in canned chunk recipes containing excess of added water or poultry fat. *Animal Feed Science and Technology*. 2007;133(3-4):309-319.
 37. Rana RVR. The effect of low dose gamma irradiation and the quality of intermediary moisture pet food. M.V.Sc, thesis, Kerala Veterinary and Animal Sciences University, Pookode; c2006. p. 81.
 38. Rani C, Prem AG, Sathu T. Development of shelf stable pet food using meat-cum-bone meal and ghee residue. *Food Safety*. 2011;7(2):49-51.
 39. Regland D, Thomas CR, Harmon BG, Miller R, Adeola O. Nutritional evaluation of two agro industrial by-products ducks and pigs. *Journal of Animal Science*. 1998;76:2845-2852.
 40. Sibbald R. The TME system of feed evaluation: Methodology, feed composition data and bibliography. Bulletin 1986-4E, Agriculture Canada, Ottawa; c1986.
 41. Troutt HF, Schaeffer D, Kakoma DI, Pearl GG. Prevalence of selected foodborne pathogens in final rendered products. *Directors digest 312*. Fats and Proteins Research Foundation, Inc., Alexandria, VA; c2001.
 42. Urlings HAP, Bijker PGH, Logtestijn JGV. Fermentation of raw poultry by-products for animal nutrition. *Journal of Animal Science*. 1993;71:2420-2426.
 43. Wells GA, Hawkins SA, Green RB, Austin AR, Dexter I, Spencer YI, *et al.* Preliminary observations on the pathogenesis of experimental bovine spongiform encephalopathy (BSE): An update. *Veterinary Record*. 1998;142(5):103-106.
 44. Yazhinidevi R, Sathu TB, Sunil B, Vasudevan VN, Naicy T, Vandana S, *et al.* Evaluation of quality and acceptability of pet pasta with buffalo tripe powder. *Journal of Veterinary and Animal Sciences*. 2022;53(1):60-64.