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Research Article

STANDARDIZATION AND EVALUATION OF DEVELOPED PET KIBBLES INCORPORATED WITH PROCESSED ANIMAL BYPRODUCT FOR DOGS

Kuleswan Pame*., Sathu, T., Vasudevan, V.N., Prajwal. S, and Gunasekaran

Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur - 680651, India

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ABSTRACT

Shelf stable pet kibbles (SSPK) for adult dogs was standardized by incorporating cereal flour mix (33%), buffalo meat (25%), meat-cum-bone meal (MCBM) (20%), offal (20%), rendered fat (RF) (5%), dietary fiber (8%) and bovine collagen peptide (1%) by baking at 150^0 C for 50 minutes. The pet kibbles were packed in PE/Al/PA laminated pouches stored at ambient temperature up to 60 days. The addition of MCBM and RF improved the overall nutrient quality, cooking yield, and palatability compared to control. Palatability and preference were evaluated based on score card and intake ratio. Palatability attributes and preferences were prominently higher for SSPK compare to control. Textural profiles like hardness, fractureability and gumminess of SSPK was significantly ($p<0.05$) lower compared to control. The hunter colour redness (a*) value in SSPK was significantly ($p<0.05$) less than control throughout the storage period. Thio Barbituric Acid Reacting Substances (TBARS), Tyrosine values (TV), Total Viable Count (TVC) and yeast and mold count significantly increased with advancement of storage period in both control and SSPK. However the increase in TBARS, TV and microbial load did not adversely affect the palatability attributes.

INTRODUCTION

The pet population of world is increasing at a robust pace especially due to a steady rise in nuclear family and increasingly being fed with commercially prepared pet foods. Majority of the pet owners are adopting dogs due to need for security and companionship. Pet food industry is expanding tremendously in the past few decades. The ever rising cost of pet food has necessitated the development of cheap as well as nutritious food, by use of slaughter house primary and secondary byproducts. Meat-cum-bone meal (MCBM), rendered fat (RF) and slaughter house byproducts are almost universally used in pet foods. Generally, they provide high quality protein with a good balance of amino acids and minerals of high nutritional quality. But rendered materials are biologically less acceptable and it gets rancid easily, therefore application of these components and oxidation issues are the most common challenges faced in their use as ingredients in pet foods. Hence this study was undertaken with an aim to develop shelf stable dry type pet kibbles of acceptable quality and to optimize the level of MCBM, RF and to compare the palatability/acceptability and preference on dogs.

MATERIALS AND METHODS

Raw materials

MCBM and RF prepared by dry rendering of bovine primary byproducts were procured from Meat Technology Unit, (MTU) College of Veterinary and Animal Sciences, Thrissur, Kerala, India. Freshly hot deboned lean buffalo meat from the round portion of adult carcass, after trimming external fat and fascia was procured from MTU and stored at 4 ± 1^0C for 24 hours for conditioning, stored frozen until further use. The offal's of buffaloes were procured from MTU, were washed and stored under frozen condition at -18^0C until further use. The cereals flours, black gram husk and wheat bran were procured from local market at Thrissur, Kerala. Collagen peptide (food grade) was purchased from Nitta Gelatin India Limited Kochi. The pet kibbles were prepared as per the formulation given in Table 1.

Table 1 Formulary for the preparation of developed pet kibbles

Sl No	Ingredients	Control Quantity (%)	SSPK Quantity (%)
1	Cereals flour mix	33.0	33.0
2	Buffalo meat	25.0	25.0
3	Offal	20.0	20.0
4	Water	11.0	11.0
5	Black gram husk	4.0	4.0
6	Wheat bran	4.0	4.0
8	Bovine collagen peptide	1.0	1.0
9	Salt	0.5	0.5
10	Turmeric powder	0.5	0.5
11	BHT	0.05	0.05
12	Brewer's yeast	0.5	0.5
13	Potassium sorbate	0.2	0.2
14	Meat cum bone meal (MCBM)	Nil	***20**
15	Rendered Fat (RF)	Nil	***5**

*MCBM and RF were added over and above the control formulation as suggested by the model design for developed pet kibbles.

Physico- chemical properties

pH: The pH was determined using a combined electrode digital pH meter µ pH system 362, Systronics, India) as per procedure of Troutt *et al*., (1992).

Corresponding author: **Kuleswan Pame**
Department of Livestock Products Technology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur - 680651, India

Determination of water activity (a_w): For determination of water activity the pet kibble samples were crushed suitably and filled in the sample cup upto the mark. The filled sample cup was kept in the measurement chamber of Labswift a_w meter (Novasina, Switzerland). The readings were taken when the stable water activity was shown in the display.

Hunter Lab Colour ($L^* a^* b^*$) : Colour of the baked pet kibbles was determined objectively as per Page *et al.* (2001) using Hunter Lab Mini Scan XE Plus Spectrophotometer (Hunter Lab, Virginia, USA) with diffuse illumination. The L* value gives a measure of the lightness of the product colour from 100 for perfect white to 0 for black, as the eye would evaluate it. The redness/greenness and yellowness/blueness are denoted by a* and b* values respectively. (Navneet and Shitiji, 2011).

Selection and weighing of ingredients (non meat ingredients)

↓

Beef and offal minced through 12mm plate ((MADO primus Model MEW 613, Germany)

↓

Blending (preparation of dough using ITALYA Mixer, Model: VFM10A, India)

↓

Molding (stainless steel molder)

↓

Baking (150^{0}C for 50min)

↓

Cooling at ambient temperature

↓

Packaging (PE/Al/PA laminated pouches using Sepack Continious sealer, Sevana, Cochin, India)

Fig. 1 Flow chart for the preparation of pet kibbles

Textural profile analysis of shelf stable pet kibbles: Hardness of the SSPK was determined by texture analyzer (Stable Micro System Ltd., TA HD plus, UK) with a 50 N load cell. Breaking strength of the SSPK was measured using HDP/BS blade. The individual SSPK samples were placed on the platform such that they were supported at two points and the blade was attached to kept at pre test speed of 2 mm/s, test speed of 3 mm/s; post-test speed of 10 mm/s. the absolute peak force from the resulting curve was considered the breaking strength of the SSPK (Bourne, 2002).

Cooking yield per cent: The weight of samples were recorded before (raw weight of dough) and after baking of pet kibbles. Per cent cooking yield was determined by calculating weight differences for sample before and after baking according to Berry and Wergin, (1992)

$$\text{Product yield (\%)} = \frac{\text{Weight of baked kibbles}}{\text{Weight of raw dough}} \times 100$$

Quality analysis: Quality analysis: The moisture content was determined by hot air oven drying, protein by automatic Kjeldhal method, fat by Soxhlet extraction with petroleum ether and total ash by muffle furnace as described in AOAC, (1990). The gross energy was found out by the equation; GE= (Protein x 0.24) + (Fat x 0.38) + (Carbohydrate x 0.17) Kienzle *et al.* (1998). The calcium and phosphorus was estimated using atomic absorption spectrophotometer. AOAC, (1990).

Thiobarbituric acid (TBA) value was estimated by extraction method described by Witte *et al.* (1970) and was expressed as mg malonaldehyde per kg of pet kibbles. The procedure of Strange *et al.* (1977) was followed for the tyrosine value with slight modifications**.** The microbiological quality of pet kibbles was assessed in respect of TVC, (Morton, 2001), yeast and mold count as per the method prescribed by (Beuchat and Cousin, 2001). Bacterial count was expressed as $\log_{10}$ cfu/g sample.

Palatability/acceptability and Preference assessment*:* The preference of the kibble samples were evaluated based on intake ratio [A/(A+B)] (Griffin *et al*., 1996). Each dog was offered 180 g of control and SSPK samples 3-4 hour after the normal feeding in two separate bowls. The position of the feeding bowls was changed randomly to avoid bias on site preference. Forty different preference tests were performed. The dogs were allowed to feed for 15 min and during this time if one bowl was emptied or rejects, then the two bowls were removed and the leftovers of kibble were recorded.

Cost of Production: Cost of production of shelf stable pet kibble was determined and compared with control. The major determinant of product cost was raw materials. The cost of production was calculated based on the prevailing market cost of the raw materials used in the formulation.

Statistical analysis: The preparation of pet kibbles and proximate composition was repeated six times and the acceptability/palatability was studied using 20 nos. of homogenous dogs over a period of 20 days per replication and the data were statistically analyzed as per Snedecor and Cochran (1994) and Siegal (1956) by using SPSS software version 21.0.

RESULTS AND DISCUSSION

Physico-chemical properties and proximate composition: The physico-chemical properties and proximate composition of SSPK compared with control are shown in the Table 2. The cooking yield of the SSPK was significantly ($p<0.01$) higher than control. The higher cooking yield in SSPK could be due to synergistic effect of MCBM and fibre ingredients to bind more water during baking process. The moisture, dry matter, protein, fat, ash and GE (Kcal/100g) content were significantly ($p<0.01$) higher in SSPK compared to control The higher protein and fat content in SSPK may be due to addition of MCBM and RF. Urling *et al.* (1993) also observed significant increase in the protein, fat and ash per cent in pet kibbles with addition of slaughter house byproducts in the form of RF, MCBM and blood in the pet foods. The average energy content in 100g of control and SSPK samples were 1683 and 1859 Kcal respectively. The significantly ($p<0.01$) higher energy content in SSPK was attributed to higher fat content in SSPK on addition of RF. This result supported the finding of Hoelscher *et al*. (1987), who reported fat content and calorie content are positively correlated. The nutrient profiles of both the control and SSPK were in line with the AAFCO, 2007 recommendation on dry matter basis for adult dog.

Colour: The colour characteristics of the control and SSPK were measured objectively in terms of L*, a* and b* values (Table 3). The redness value (a*) significantly ($p<0.05$) decreased on addition of MCBM and RF, which might be due to dilution of meat pigment concentration leading to decrease in redness value and lower dispersion of the cereals flour mix in the products. This observance was in accordance with Claus *et al.* (1989), who reported that the meat products with high fat level could decrease the redness.

Textural characteristics: Hardness, fractureability and gumminess value for SSPK was significantly ($p<0.01$) lower as compared to control. The addition of RF might had resulted in weaker solid matrix due to lesser interaction of the fat with other ingredients and higher water binding by addition of MCBM might had resulted in softer texture profile in SSPK. Giese, 1996 reported that the fat generally modifies the textural characteristics by interacting with the other ingredients of the food to develop a soft and smooth mouth feel.

Palatability-Preference and Intake Ratio: It was observed that the owner's preference attributes (odour, colour and appearance) and dogs palatability attributes towards SSPK was highly distinguishable from that of control pet kibbles (Fig.2 a). The intake ratio (IR) of SSPK was significantly ($p<0.05$) higher compared to control samples (Fig. 2 b). The IR of SSPK scored 64 per cent and control pet kibble scored 36 per cent. From the observation of palatability attributes scores and intake ratio per cent it can be inferred that pet kibbles containing 20 per cent MCBM and 5 per cent RF were having higher palatability and overall preference than control. It might be due to the better flavour and texture in SSPK due to the addition of MCBM and RF. These findings agrees with those of Dust *et al*. (2005), who reported that the use of animal protein and fat in the pet foods, improved the palatability, enhanced its physical attributes and owners preference.

Table 2 Physico-Chemical characteristics and proximate composition of control and standardized pet kibbles

Parameters	Control	SSPK	Significance
pH	5.46±0.03	5.32±0.02	NS
Water activity (a_w)	0.54±0.08	0.54±0.02	NS
Cooking yield (%)	56.81±0.46	66.70±0.53	**
Moisture (%)	9.77±0.11	10.31±0.17	**
Dry matter (%)	90.29±0.10	89.68±0.17	**
Crude protein (%)	18.08±0.34	21.91±0.43	**
Fat (%)	6.49±0.24	14.97±0.35	**
Crude fiber (%)	3.48±0.09	3.45±0.06	NS
Total ash (%)	6.52±0.12	7.43±0.20	*
Calcium (%)	2.06±0.03	2.24±0.09	NS
Phosphorus (%)	1.04±0.08	1.17±0.06	NS
Carbohydrate (%)	59.12±0.47	46.16±0.77	**
NFE (%)	55.64±0.48	42.71±0.76	**
GE (Kcal/100g)	1683±0.07	1859±0.07	**

Control (Pet kibbles without MCBM and RF) and
SSPK- (Pet kibbles with C+ 20% MCBM + 5% RF).
NS- Non Significant, *p<0.05, **p<0.01,

Table 3 Effect on Colour (Hunter L*a*b*) of Control and Standardized pet kibbles

Parameter	Control	SSPK	Significance
L* (lightness)	30.70±0.43	31.60±0.35	NS
a* (redness)	7.85±0.15	6.08±0.13	*
b* (yellowness)	21.12±0.46	20.42±0.20	NS

Control (Pet kibbles without MCBM and RF) and SSPK- (Pet kibbles with C+ 20% MCBM + 5% RF), NS- Non Significant, *p<0.05

Table 4 Effect on Texture profile analysis of Control and Standardized pet kibbles

Parameters	Control	SSPK	Significance
Hardness (N)	100.48±12.29	33.90±7.45	**
Fracturability (N)	16.60±2.43	5.50±0.72	**
Springiness (cm)	0.21±0.02	0.16±0.02	NS
Cohesiveness ratio	0.87±0.02	0.79±0.33	NS
Gumminess (N)	5.47±0.73	1.63±0.27	**
Chewiness (N cm)	5.99±1.04	4.97±0.55	NS

Control (Pet kibbles without MCBM and RF) and SSPK- (Pet kibbles with C+ 20% MCBM + 5% RF), NS- Non Significant, *p<0.05.

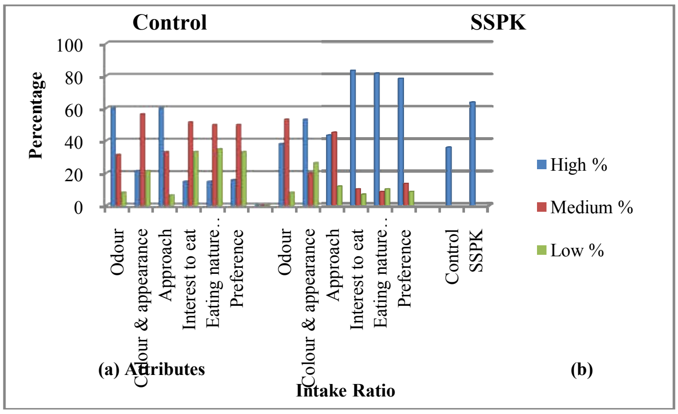

Fig 2 Comparison between Control and Standardized pet kibbles on (a) Different palatability attributes on dog and dog owners (b) Intake ratio on dogs

Storage stability of shelf stable pet kibbles

The TBARS values of control and SSPK (Fig. 3.) increased ($p<0.05$) from 0.31-4.45 and 0.89-5.15 mg malonaldehyde/kg pet kibble respectively during storage period. Similar increase in TBARS value was also reported in dog pet foods added with dry rendered spent hen meal during the storage period by Rajendra Kumar *et al.* (2011). Tyrosine value (TV) of both control and SSPK increased significantly ($p<0.05$) during storage period (Fig. 4.). TV of control increased from 28.89-103.44 and that of SSPK 37.59-104.92 mg tyrosine/ 100 g kibble. The increase in the TV during storage might be due to the protein breakdown by chemical and microbial action. Similar result with increase of TV on storage have been reported by Karthik *et al*. (2010) in spent hen meal based pet food prepared by extrusion. Dainty *et al.* (1975) opined that the increase in concentration of tyrosine occurs due to microbial proteolytic enzymes action on protein substrate.

TVC increased from $\log_{10}$ 2.10-7.56 cfu/g in control and 3.79-7.67 cfu/g in SSPK (Fig. 5), whereas yeast and mold increased from $\log_{10}$ 1.90-6.03 cfu/g in control C_3 and 1.98-6.99 cfu/g in SPK (Fig. 6). Similar increase in the microbial count was reported by Karthik (2007) in dry pet food prepared by incorporating poultry byproducts meal. The significantly ($p<0.05$) higher TVC and yeast and mold count noted in SSPK compare to control throughout the storage period might be due to less heat penetration due to higher fat content in SSPK, and more nutrient content available (Table 2.) for the microbes due to addition of MCBM and RF might have favoured the microbial growth. Wirth (1972) reported that low fat products have better shelf life than full fat products due to more heat penetration in low fat products.

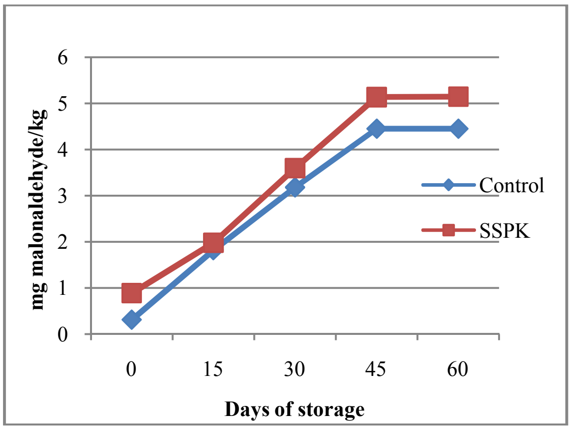

Fig 3TBARS values of Control and SSPK on storage period of at ambient temperature

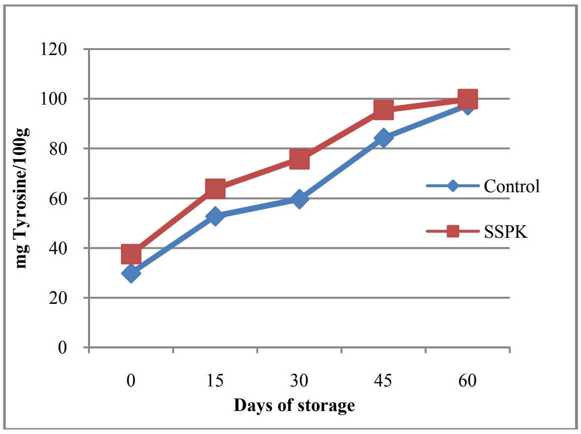

Fig 4 Tyrosine Value of Control and SSPK on storage period at ambient temperature

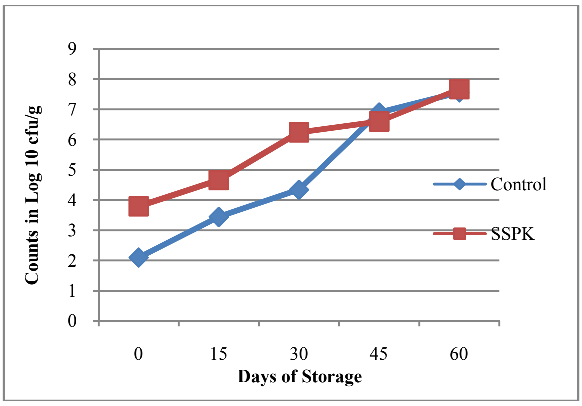

Fig 5 Growth trend of TVC of Control and Standardized pet kibbles on storage period at ambient temperature

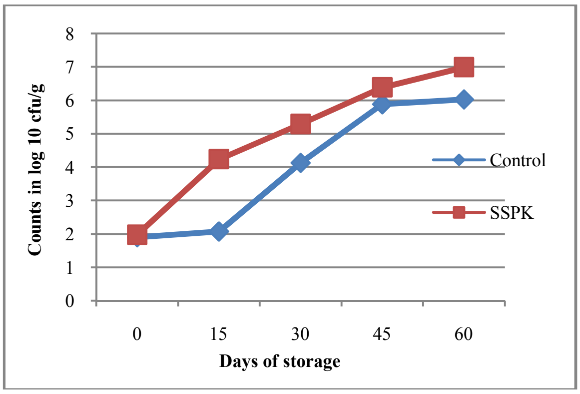

Fig 6 Growth trend of Yeast and mould of Control and Standardized pet kibbles on storage period at ambient temperature

Cost of production: The cost of production of shelf stable pet kibbles with 20 % MCBM and 5% RF levels worked out to be Rs. 148.00/ kg. The cost of commercially available pet foods in India ranged from Rs. 180 -220/kg. The SSPK in this study have the nutritional profile in line with the standards of AFFCO (2007) recommendation for adult dog food. Hence it can also be marketed as pet food at a cost lower than the commercially available pet foods.

CONCLUSION

Shelf stable pet kibbles with good nutritive quality and palatability for dogs can be prepared by incorporating 20 % MCBM and 5 % RF, and it can be safely stored up to 60 -90 days at ambient temperature in PE/Al/PA laminated pouches. A lower production cost of the pet kibbles prepared in the present study compared to the commercially available pet foods is an inductive of its good market potential.

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