J.Meat Sci., 2011, 7(1) : 53-55

Research Note

Optimization of the Level of Mushroom in Analogue Meat Nuggets

Pavan Kumar , B.D. Sharma* and R. R. Kumar
Division of Livestock Product and Technology
Indian Veterinary Research Institute, Izatnagar-243 122, U.P.

ABSTRACT

Meat analogue is mock meat that is made from non-animal protein and its appearance and smell are very much like real meat. Analogue meat nuggets were prepared as per basic formulation under standardized processing conditions with three different levels of mushroom viz. 18%, 22.5% and 27% replacing textured soy protein. Among the physico-chemical parameters pH and protein percent decreased significantly (P<0.01) with increase in levels of incorporation whereas cooking yield increased. Moisture percent of analogue meat nuggets at 27% level of mushroom incorporation was significantly higher (P<0.01) as compared to other two levels. All the sensory attributes except general appearance and juiciness were significantly higher (P<0.01) at 22.5% mushroom level as compared to 18% and 27% levels which were comparable to each other. On the basis of sensory rating 22.5% mushroom incorporation was selected as the optimum in analogue meat nuggets.

Meat analogue is a food product that approximates the aesthetic qualities and /or chemical characteristics of certain types of meat. Thus meat analogue is mock meat that is made from non-animal protein and its appearance and smell are very much like real meat. Young and Young (2007) patented the procedure of preparing meat analogue by mushroom mycelia with low-calorie synthetic meat with meat like flavor. According to USDA (2006) mushrooms are a natural source of vitamin D, a vitamin difficult to include in a plant-based diet since other vitamin D food sources are meat- and dairy-based products. Mushrooms contain antioxidants and are a good source of the B vitamins riboflavin (B2), niacin (B3) and pantothenic acid (B5). Cheskin *et al* (2008) reported that a serving of four-five white button mushrooms has 20 calories and no fat, but is nutrient-rich. In fact, mushrooms are also the leading source of the antioxidant selenium and a good source of the B vitamins viz. riboflavin, niacin and pantothenic acid, which help to break down proteins, fats and carbohydrates. The aim of present study was to optimize the levels of mushroom in analogue meat nuggets based on sensory attributes.

*Corresponding author: e-mail: sharma_bd@yahoo.com

Three different levels of mushroom viz.18%, 22.5% and 27% replacing texturized soy protein in the initial formulation, were used to find out the optimum level of mushroom in meat analogue. Textured soy protein *(Nutrela)* were hydrated by soaking in 1.5 times water for 15 minutes and ground in grinder for 20 seconds. *Colocybe indica* (*dudhchatta*) mushrooms were cleaned and ground into fine paste. Broken wheat was hydrated in water (2:1 ratio) for 15 minutes and subjected to grinding. Ground textured soy protein was mixed in Hobart paddle mixture with ground mushroom and wheat paste for 1 minutes followed by addition of refined soy oil and blending for 30 seconds. After addition of *singhara flour*, gram flour and *arra-root flour* into the mixture, mixing continued for another 30 seconds. Finally salt, spices, nitrite, sugar, polyphosphates, gum, sodium caseinate, monosodium glutamate, carrageenan and flavouring ingredients were added as per Table-1 and mixed for another 30 seconds. The mixture was filled in boxes and subjected to steam cooking for 20 minutes without pressure and after cooling, sliced and cut into pieces to get nuggets.

The products were evaluated for pH, cooking yield and proximate composition. The pH of analogue meat nuggets was measured by digital pH meter (model

Table 1: Initial formulation for analogue meat nuggets

Ingredients	Amount (g/100g)
Ground textured soy protein	40/35.5/31
Ground Mushroom	18/22.5/27
Wheat gluten paste	10
Refined soy oil	10
Garlic paste	6
Arra-root flour	3
Gram flour	3
Singhara flour	2.5
Sodium caseinate	1.5
Gum acacia	1.5
Dry spices	1.25
Salt	1.25
Flavouring mixture (reducing sugar*, **a***,**b*** and **c***amino acids)	1.00
Carrageenan	0.5
Polyphosphates	0.4
Sugar	0.3
Monosodium glutamate	0.3

IPR issues

CP 901, Century Instrument Ltd. India) using combined glass electrode (Keller *et al.*1992). The cooking yield was recorded by noting the weight of analogue meat block before and after processing. Proximate composition of analogue meat nuggets was determined and expressed as percent as per the methods outlined by AOAC (1995). Moisture: Protein ratio content of analogue meat nuggets was determined from the derived values. The products were evaluated for appearance, flavour, juiciness, texture, saltiness and overall acceptability, using 8-point descriptive scale (Keeton, 1983), where 8 is extremely desirable and 1 is extremely undesirable. The data obtained were subjected to statistical analysis (Snedecor and Cochran, 1989) for analysis of variance and Duncan s multiple range test to compare the means.

Moisture and fat percent, moisture: protein ratio and cooking yield increased with increase of mushroom incorporation levels whereas pH and protein percent decreased (Table-2). The pH values of analogue meat nuggets decreased significantly ($P<0.01$) with increase in levels of mushroom due to inherent acidic nature of mushroom. An increase in cooking yield of the analogue nuggets with increase in mushroom level was well supported by corresponding increase in moisture. Moisture percent at 27% level of incorporation of mushroom was significantly higher ($P<0.01$) as compared to 18% and 22.5% levels. The protein percentage decreased significantly ($P<0.01$) with progressive increase in the incorporation of mushroom levels replacing textured soy protein could be due to difference in the protein content of textured soy protein chunks (higher) and mushroom (lower). The moisture: protein ratio being a derived parameters showed significantly higher values ($P<0.01$) with increase in incorporation levels of mushroom.

Mean sensory scores of nuggets incorporated with different levels of mushroom (Table-2) revealed a significant increase in sensory scores of almost all attributes at 22.5% level as compared to other levels of incorporation. However at 27% level of incorporation, all sensory attributes had significantly lower scores ($P<0.05$) as compared to 22.5% level. General appearance scores comparable to all incorporation levels with marginal decline due to lighter colour upon replacing textured soy protein chunks with mushroom. Uzunov and Colova (1972) reported light grey colour of sausages upon addition of mushroom. Sung *et al*. (2001) also reported similar findings in fish meat paste due to addition of mushroom.

The flavour sores of the product with 22.5% added mushroom level were significantly higher ($P<0.01$) than that of other levels. The initial increase in flavour scores with increase in incorporation might be due to preference of mushroom flavour of fungal protein in comparison with the 'beany' flavour of textured soy protein whereas at 27% mushroom incorporation, the excess of mushroom flavour could have led to decrease in flavour scores. Kibler et al. (1988) reported production of high concentration of 1-octen-3-ol, a major volatile flavouring component in many mushroom species due to heating of homogenized mushrooms in aqueous medium containing a water-soluble salt of linoleic acid and oxygen. The

Table 2: Effect of different levels of mushroom on physico-chemical and Sensory quality of analogue meat nuggets. (Mean ±SE)*

Physico-chemical parameters*	Mushroom		
	18%	22.5%	27%
pH	6.12^{a}±0.01	6.06^{b}± 0.01	5.94^{c}±0.01
Cooking Yield	91.37^{c}±0.01	92.45^{b}±0.02	94.49^{a}±0.01
Moisture	49.84^{b}±0.23	50.16^{b}±0.43	52.16^{a}±0.47
Protein	14.79^{a}±0.2	13.46^{b}±0.05	12.02^{c}±0.04
Fat	9.87±0.11	9.91±0.18	10.10±0.23
Moisture: Protein Ratio	3.37^{c}±.05	3.73^{b}±0.04	4.34^{a}±0.04
Sensory Attributes**			
General appearance	6.75±0.12	6.63±0.09	6.62±0.11
Flavour	6.45^{b}±0.12	7.04^{a}±0.08	6.55^{b}±0.13
Juiciness	6.62±0.13	6.70±0.11	6.63±0.10
Texture	6.56^{b}±0.13	7.03^{a} ± 0.09	6.47^{b}±0.12
Binding	6.35^{ab}±0.06	6.53^{a} ± 0.10	6.10^{b}±0.10
Overall acceptability	6.49^{b}±0.09	7.19^{a}±0.09	6.41^{b}±0.10

Means ±SE with different superscripts in a row differ significantly (P<0.05).
Sensory Scores based on 8 point descriptive scale where 8- extremely desirable and 1- extremely poor
* n= 6 for each treatment ** n= 21 for each treatment

scores for texture and binding attributes of nuggets showed similar trend as that of flavour. The scores for both the attributes at 22.5% level of incorporation were significantly higher (P<0.01) than the other two. The initial increase in texture and binding scores could be attributed to the availability of optimum amount of water in ground mushroom, whereas excess water in surplus at higher level of incorporation (27%) had adverse effect on texture and binding scores.

Overall acceptability of the product increased with increase in level of incorporation of mushroom up to 22.5% and then decreased at higher mushroom levels (27%). Improvement in overall acceptability score could be due to increase in flavour, binding and texture scores at 22.5% levels in nuggets, whereas at 27% level it dropped along with other sensory attributes.

On the basis of above sensory ratings, it was concluded that 22.5% mushroom level by replacing textured soy protein was optimum in analogue nuggets.

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