

Studies on Development of Meat Analogue Rolls Using Various Plant Sources

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Abstract: A study was conducted with an objective to develop meat analogue rolls using various plant sources. Wheat, bajra, maize and sorghum flours were taken at different levels (alternatively with all permutation combination at 0, 25, 50 and 75%) for selection of cereal mix base and Textured Soya Protein (soaked soy grits), cowpea (flour) and mushroom (paste) were taken (alone and in combination alternatively with all permutation combination at 0, 25, 50 and 75% levels) as protein supplements with selected cereal mix base. The products were selected on the bases of texture profile analysis and sensory evaluation. However, on the bases of texture profile analysis the cereal mix flour (wheat 50% + maize 50%) and (bajra 75% + maize 25%) were found very similar to control (chicken meat rolls) but panelists rejected rolls having bajra due to a bitterness in taste (organoleptically). Hence, cereal mix base with wheat flour and maize flour (1:1) was selected for further studies. The meat analogue rolls prepared with a combination of selected cereal mix base (50%) + textured soy grit (soaked) 25% + mushroom paste 25% were finalized for development of meat analogue rolls on the bases of texture profile analysis and sensory scores which were almost similar to chicken meat rolls. It is concluded that meat analogue rolls can be prepared from combinations of wheat flour 25% + maize flour 25% + textured soy grit (soaked) 25% and mushroom paste 25% without compromising the textural and sensory characters in comparison to the chicken meat rolls.

Keywords: Analogue Rolls, Chicken Meat, Plant Sources, Sensory, Texture Profile.

1. INTRODUCTION

Although meat is a very nutritious and high quality food but during processing, it is usually turned unhealthy due to incorporation of large quantity of saturated fat. Consumption of meat products have been associated with increased risk of cardio vascular diseases, hypertension, obesity, colorectal cancers etc [1].

A meat analogue is a designed food product that is made to have similar texture, colour, taste and form as meat that looks and taste like meat [2]. Another advantage of meat analogues over meat products is that they are a rich source of fiber because they are made from plant or fungi sources. Moreover, there is a severe shortage of protein of high biological value in developing countries, and the cost of meat is very high. More specifically, protein-energy malnutrition is among the most serious problems faced by developing countries today [3]. Plant proteins such as gluteins of wheat, peanut, yeast, and soybean are the main source of material for development of meat analogues [4]. Soybean is a good source of high quality protein due to its relatively well balanced composition of amino acids [5], [6]. These also provide a texture and meat like taste with

other ingredients.

Now, it is the responsibility of the food technologists to provide this vegetarian segment as an alternative of meat which is tasty as well as nutritious. Therefore, the study was undertaken to utilize different plant sources for development of good quality meat analogue rolls.

2. MATERIALS AND METHODS

Meat analogue rolls were prepared using various cereal flour combinations like wheat (*Triticum aestivum*), maize (*Zea mays*), sorghum (*Sorghum bicolor*) and bajra (*Pennisetum glaucum*) at different levels alternatively with all permutation combinations at 0, 25, 50 and 75 percent levels for selection of cereal mix base (CMB) for further studies. The combinations were as follows:

C=Control (Chicken Meat Rolls), T₁=100%Wheat, T₂=75% Wheat+25% Bajra, T₃=50%Wheat+50%Bajra, T₄=25%Wheat+75%Bajra, T₅=100%Bajra, T₆=75%Wheat+25%Maize, T₇=50%Wheat+50%Maize, T₈=25%Wheat+75%Maize, T₉=100%Maize, T₁₀=75%Wheat+25%Sorghum, T₁₁=50%Wheat+50%Sorghum, T₁₂=25%Wheat+75%Sorghum, T₁₃=100%Sorghum, T₁₄=75%Bajra+25%Maize, T₁₅=50%Bajra+50%Maize, T₁₆=25%Bajra+75%Maize, T₁₇=75%Maize+25%Sorghum, T₁₈=50%Maize+50%Sorghum, T₁₉=25%Maize+75%Sorghum, T₂₀=75%Bajra+25%Sorghum, T₂₁=50%Bajra+50%Sorghum, T₂₂=25%Bajra+75%Sorghum.

Soaked textured soya protein grit (brand name Nutrela manufactured by Ruchi Soy Industries Ltd., Mumbai), cowpea (*Vigna unguiculata*) flour and Button mushroom (*Agaricus bisporus*) paste were used as protein source at different levels alternatively with all permutation combinations at 0, 25, 50 and 75 percent levels with selected CMB to develop the final product. The combinations were as follows:

C=control, P₁=50% CMB+50% cowpea, P₂=50% CMB+50%TSP, P₃=50%CMB+25%cowpea+25%TSP, P₄=50%CMB+25%TSP+25% mushroom, P₅=50%CMB+25%cowpea+25% mushroom, P₆=50%CMB+50% mushroom.

The meat analogue rolls were prepared following the standard processing steps, along with other additives (sodium chloride 2%, sodium tri-polyphosphate 0.4%, sodium nitrite 100 ppm, Condiments 4%, spice mix. 2%, soy refined oil 4% and ice flakes 15%), which were used in control (chicken meat rolls) in similar concentrations. After mixing of additives and other ingredients, emulsion was prepared in bowl chopper. Emulsion was filled in autoclavable beakers. The rolls were cooked in pressure cooker for 30 min and then cooled rolls were cut in to 5 mm slices. All the ingredients were procured from local market of Hisar. The products were selected on the bases of texture profile analysis and sensory evaluation.

The textural properties of meat analogue and chicken m-

eat rolls were evaluated using texture-meter (Food Technology Corporation, USA) using central cores of each sample (1cm³) which were compressed to 50% of the original height [7]. A crossed head speed of 3mm/sec was used. The following parameters were determined:

1. Hardness (N /cm² or g/mm²) = maximum force required to compress the sample (H).
2. Springiness (Cm/mm) = ability of sample to recover its original form after a deforming force was removed (S).
3. Cohesiveness = extent to which samples could be deformed prior to rupture (A2/A1, A1 being the total energy required for first compression and A2 the total energy required for second compression).
4. Adhesiveness (ns/g sec.) = work necessary to pull the compressing plunger away from sample.
5. Gumminess (N/cm² or g/mm²) = force necessary to disintegrate a semisolid sample for swallowing (H X Cohesiveness).
6. Chewiness (N/cm or g/mm) = work required to the sample for swallowing (S × Gumminess).

Sensory evaluation scores which included colour, flavor, appearance, tenderness, juiciness and overall acceptability were evaluated using 9-point Hedonic scale by six semi-trained judges.

The experiment was replicated thrice in duplicate and subject to statistical analysis using completely randomized design [8].

3. RESULTS

A. Screening of cereal combinations on the basis of texture profile analysis:

The hardness (N/cm²) values of meat analogue rolls prepared with treatment T₇ (wheat 50%+ maize 50%) and T₁₄ (bajra 75% + maize 25%) were recorded 9.78 and 9.74, respectively, which were nearest to the hardness value (9.76) of control samples (Table 1). The chewiness (N/cm) values of control (166.97) and meat analogue rolls prepared with treatment T₇ (153.31) found highest among all the samples and were almost similar to each other.

However, adhesiveness (ns/g sec) values of meat analogue rolls prepared with T₇ (0.91), T₁₄ (0.89) and T₁₉ (0.89) combinations were nearest to the value of control (0.90) sample but this textural character values of various treatment combinations were also ranged from 0.81 to 0.91 including control sample and did not indicate any considerable differences among each other, except the treatment values of T₃, T₁₀, T₁₁, T₂₀ and T₂₁ which were lower than control.

The similarities in textural properties of control, T₇ and T₁₄ treatments regarding springiness (cm / mm) values (27.4, 27.05 and 18.62, respectively), gumminess (N/cm²) values (8.90, 8.13 and 7.60, respectively) and cohesiveness scores (1.28, 1.26 and 1.48, respectively) were clearly indicated in Table 1.

Considering all these findings on the basis of texture profile analysis from the meat analogue rolls prepared with treatments of T₇ (wheat 50% + maize 50%) and T₁₄ (bajra 75% + maize 50%) were considered for the sensory

evaluation to selection the cereal mix base for further studies.

B. Selection of cereal mix base on the basis of sensory evaluation:

All the sensory characters including overall acceptability scores for treatment T₁₄ (bajra 75% + maize 25%) were significantly lower as compared to control and T₇ (wheat 50% + maize 50%) samples (Table 2). Moreover, panelists reported a bitterness feeling in the rolls prepared with bajra flour (T₁₄), and hence rejected for further studies. Therefore, on the basis of texture profile analysis and sensory evaluation the meat analogue rolls (T₇) prepared with wheat: maize (1:1) was selected as cereal mix base for further development of meat analogue rolls.

Table 1. Screening of cereal combinations on the basis of texture profile analysis. (n=6)

Treatment	Parameters					
	Hardness (N/cm ²)	Chewiness (N/cm)	Adhesiveness (ns/g sec)	Springiness (cm/mm)	Gumminess (N/cm ²)	Cohesiveness
C	9.78	166.9	0.9	27.4	8.9	1.28
T ₁	8.06	0.72	0.87	1.32	0.52	0.55
T ₂	9.7	0.85	0.88	9.62	0.57	0.26
T ₃	10.43	8.39	0.66	8.7	3.59	0.34
T ₄	10.47	9.58	0.81	8.33	2.79	0.21
T ₅	10.07	8.61	0.82	7.48	2.66	0.21
T ₆	9.63	10.25	0.87	7.58	1.55	0.14
T ₇	9.74	153.3	0.91	27.05	9.13	1.26
T ₈	12.94	36.28	0.87	10.16	2.36	0.2
T ₉	7.43	8.36	0.87	7.5	0.64	0.09
T ₁₀	10.44	17.92	0.44	4.66	3.04	0.36
T ₁₁	10.1	44.5	0.68	3.25	4.57	0.77
T ₁₂	13.56	18.5	0.88	2.53	2.65	0.23
T ₁₃	12.41	2.61	0.88	2.36	1.27	0.14
T ₁₄	9.76	51.43	0.89	18.62	7.6	1.48
T ₁₅	9.29	16.07	0.88	3.76	2.45	0.07
T ₁₆	8.5	17.96	0.88	11.34	1.67	0.15
T ₁₇	6.51	3.69	0.88	7.14	0.96	0.15
T ₁₈	5.47	3.8	0.87	8.58	0.61	0.14
T ₁₉	6.48	3.5	0.89	10.27	0.84	0.15
T ₂₀	7.78	10.34	0.33	3.49	3.09	0.29
T ₂₁	10.53	48.03	0.65	4.7	3.63	0.28
T ₂₂	12.58	30.78	0.87	3.37	2.57	0.25

Table 2. Selection of cereal base mix on the bases of sensory evaluation (n=6)

Parameter	Control	T ₇	T ₁₄
Colour	8.50 ^c	7.33 ^b	6.33 ^a
	± 0.54	± 0.51	± 0.51
Flavour	8.33 ^b	7.50 ^b	5.50 ^a
	± 0.51	± 0.54	± 0.54
Tenderness	7.33 ^b	8.16 ^b	6.16 ^a
	± 0.51	± 0.51	± 0.41
Juiciness	8.16 ^c	7.33 ^b	6.16 ^a
	± 0.41	± 0.51	± 0.40
Texture	8.16 ^b	7.50 ^b	6.50 ^a
	± 0.54	± 0.54	± 0.55
Overall Acceptability	8.16 ^c	7.33 ^b	6.00 ^a
	± 0.41	± 0.40	± 0.54*

Means with different superscripts in rows differ significantly (P≤0.05).*(bitterness)

C. Screening of various plant protein sources on the basis of texture profile analysis:

The hardness values (N/cm²) of meat analogue rolls prepared with combinations of 50% selected cereal mix base (T₇) and 25% TSP + 25% mushroom (P₄) were (8.66) nearest comparable with the values (9.78) of chicken meat rolls (Table 3). The meat analogues prepared with the selected cereal mix and other plant protein sources showed the hardness values ranged from 4.89 to 6.18, which were considerably lower than the value of control and P₄ samples.

It was indicated from Table 3 that the other textural characters like chewiness (95.97 N/cm), springiness (27.39 cm or mm), adhesiveness (0.9 ns/g sec.), gumminess (8.9 N/cm²) and cohesiveness score (1.28) of chicken meat rolls (control) were nearest comparable with the respective textural character values of meat analogue rolls (72.89 N/cm, 22.10 cm or mm, 0.9 ns/ g sec., 8.51 N/cm² and 1.22, respectively) prepared with selected cereal mix 50% in combination with the treatment P₄ (TSP 25% + mushroom 25%).

Table 3. Screening of various plant protein sources on the basis of texture profile analysis

Treatments	Parameters					
	Hardness (N/cm ²)	Chewiness (N/cm)	Adhesive (ns/g sec)	Springiness (cm/mm)	Gumminess (N/cm ²)	Cohesiveness
C	9.78	95.97	0.9	27.39	8.9	1.28
P ₁	4.89	21.74	0.92	13.09	11.72	2.29
P ₂	5.4	26.03	0.93	10.48	10.58	2.59
P ₃	5.69	37.7	0.89	9.35	11.71	2.5
P ₄	8.66	72.89	0.9	22.1	8.51	1.22
P ₅	6.18	46.43	0.9	15.65	12.09	3.58
P ₆	5.56	36.59	0.89	10.45	5.14	0.36

D. Selection of plant protein combinations on the basis of sensory evaluation:

It was revealed from Table 4 that all the sensory attributes including over all acceptability scores, except colour, of the developed meat analogue rolls (treatment P₄) were statistically similar to the control (chicken meat roll) sample. Therefore, on the basis of texture profile analysis and sensory quality evaluation of developed meat analogue rolls prepared with combinations of selected cereal mix 50% and TSP 25% + mushroom 25% was selected.

4. DISCUSSION

A. Screening of cereal combinations on the basis of texture profile analysis:

It was found that the mostly textural properties like hardness (N/cm²), chewiness (N/cm), adhesiveness (ns/g sec.), springiness (cm or mm), gumminess (N/cm²) values and cohesiveness scores of meat analogue rolls prepared with treatment T₇ (wheat 50%+ maize 50%) and T₁₄ (bajra 75% + maize 25%) were nearest to the control samples (Table 1). These finding are in accordance with the line of

Howsam who concluded that the industrial manufacture of meat analogue products from plant based precursors such as cereal grain gluten of wheat and maize, alone or in combination, should be taken up on a regular basis [9].

It is well known fact that the functionality of protein ingredients results from their molecular structure, method of processing and their interactions with other ingredients in the food products [10]. Perhaps, by blending properly selected protein sources (wheat, maize and bajra), it was possible for the amino acid profile in the protein sources to complement one another so that the resulting protein more nearly approximate that of complete or balanced protein [11]

The various plant protein sources which could be used for food processing was not only limited to soy protein, but traditional wheat protein, would be mostly used for meat analogue production [12], [13].

B. Selection of cereal mix base on the basis of sensory evaluation:

All the sensory characters including over all acceptability scores for T₁₄ (bajra 75% + maize 25%) were significantly lower as compared to chicken meat roll and T₇ (wheat 50% + maize 50%) samples (Table 2). Moreover, panelists reported a bitterness feeling in the rolls prepared with bajra flour (T₁₄), and hence rejected for further studies.

It has also been reported earlier that malt from bajra had an unpleasant smell and a very bitter taste after a few days of storage. It was due to its high lipase enzymes from attacking the fatty acids creating bitter taste in bajra flour [14].

C. Screening of various plant protein sources on the basis of texture profile analysis:

The textural characters like hardness (N/cm²), chewiness (N/cm), adhesiveness (ns/g sec.), springiness (cm or mm), gumminess (N/cm²) values and cohesiveness scores of developed meat analogue rolls prepared with selected cereal mix base 50% and TSP 25% + mushroom 25%(P₄) were nearest comparable with the textural values of control chicken meat rolls (Table 3).

It has also been reported by many workers that textured soy proteins are most suitable substitute for meat analogue [6].

The fungal protein gave convincing meat, poultry and fish analogues by alignment of the protein filaments with fibrous or flaky texture [15]. The texture of the processed mycelia product of A35 strain of *Fusariumgraminearum* was similar to meat fibre and it could be made into a passable imitation of fish, chicken, veal or ham [16]. A composition for making of meat like products by using the edible mushroom was patented in 1988 [17]. Fishmeat paste prepared with 15% mushroom had highest values for strength, hardness, gumminess and brittleness [18].

D. Selection of plant protein combinations on the basis of sensory evaluation:

All the sensory attributes including over all acceptability scores, except colour, of developed meat analogue rolls (P₄) were statistically similar to the chicken meat roll samples (Table 4).

Instrumental tests employed for textural properties of developed meat analogue and chicken meat rolls were almost similar and a strong correlation of textural values with sensory evaluation panel (tenderness, juiciness,

Table 4. Selection of plant protein combinations on the basis of sensory evaluation (n=6)

Treatments	Parameters					
	Colour	Flavor	Tenderness	Juiciness	Texture	OA.Acpt.
Control	8.33 ^c ±0.51	8.66 ^d ±0.51	7.66 ^c ±0.51	8.16 ^d ±0.75	8.33 ^c ±0.51	8.66 ^c ±0.51
P ₁	6.50 ^a ±0.54	3.33 ^a ±0.51	4.33 ^a ±0.51	3.83 ^a ±0.75	4.33 ^b ±0.51	5.16 ^a ±0.75
P ₂	6.16 ^a ±0.75	4.16 ^b ±0.75	4.16 ^a ±0.40	3.33 ^a ±0.51	4.83 ^b ±0.75	5.16 ^a ±0.75
P ₃	6.83 ^a ±0.75	4.66 ^b ±0.51	4.33 ^a ±0.51	4.16 ^a ±0.75	3.33 ^a ±0.51	5.33 ^a ±0.51
P ₄	7.66 ^b ±0.51	8.16 ^d ±0.75	7.33 ^c ±0.51	8.33 ^d ±0.51	8.33 ^c ±0.51	8.33 ^c ±0.51
P ₅	6.16 ^a ±0.75	5.16 ^c ±0.75	4.33 ^a ±0.51	3.33 ^a ±0.51	5.16 ^c ±0.75	4.83 ^a ±0.75
P ₆	6.16 ^a ±0.51	5.16 ^c ±0.75	5.66 ^b ±0.81	7.16 ^c ±0.75	6.33 ^d ±0.51	6.16 ^b ±0.75

Means±SD with different superscripts in columns differ significantly (P≤0.05)

texture and over all acceptability scores) [19]. Textured soy products compressed in an Ottawa Texture Measuring System showed that the products could be separated into various classes on textural basis [20]. Further study by Loh and Breene showed that data obtained by this method correlated well with sensory characters evaluation [21].

The meaty flavour of developed meat analogue rolls might be contributed by soaking of soy grits in hot water during processing. Bridget and Sanusi reported that soy during soaking underwent natural acid fermentation with a reduction in pH from 7.10 to 5.40 to yield peptides or, eventually, their constituent amino acids; however, it was already claimed by Giese that acid hydrolysis is used to produce the hydrolyzed vegetable proteins (HVP), which have meaty flavour profiles [22], [23].

Another factor which enhanced the meaty flavour in developed meat analogue rolls was contribution of volatile flavouring components of mushroom. The sensory analysts found that samples with 5% mushroom in fish meat paste obtained the higher scores for taste and overall acceptability scores. It was further reported that flavour scores were highest for fish pastes containing 20% mushroom [18]. The high concentration of 1-octen-3-ol contributed meaty flavour, which is a major volatile flavouring component of many mushroom species [24].

The organoleptic quality of mushroom based meat sausages was improved with specific flavour imparted by the mushrooms [25].

It was reported by Caglarirmak that mushroom is very good source of iron and sulfur containing amino acids [26]. Perhaps, the colour scores of developed meat analogue rolls were lower than that of chicken meat rolls due to contribution of iron and sulfur by mushroom for formation of iron sulfide during processing which caused a gray colour to the developed product [25].

5. CONCLUSIONS

It is concluded that good quality meat analogue rolls can be prepared from combinations of wheat flour 25% + maize flour 25% + textured soy grit (soaked) 25% and mushroom paste 25% without compromising the textural and sensory characters in comparison to the chicken meat rolls.

REFERENCES

- [1] Fernandez-Gines, J.M., Fernandez-Lopez, J., Sayas-Barbara, E. and Perez-Alvarez, J.A. (2005). Meat products as functional food: A review. *J. Food Sci.* 70: 37-43.
- [2] Soya Foods Association of North America. (2010). <http://www.soyfoods.org/soy-products/sales-and-trends>.
- [3] Mahalik, N.P. (2008). Survey on Food Processing and packaging technology. Mini Symposium on Industrial Technology Links, Sponsored by Advance Technology Enterprises, California State University, Fresno, USA, March 13, Pp: 1-40.
- [4] Reiser, R., Gumudavelli, V., Gharibian, W., James, L. and Yonemoto, L.H. (2009). Meat analog product. *United States Patent No: 426104*.
- [5] Hodges, L.S. and Flynt, C. (2004). Meat Analogs. Nutrition and Well-Being A to Z. 2004. www.healthline.com/galecontent/meat-analogs.
- [6] Egbert, R. and Borders, C. (2006). Achieving success with meat analogs. *Food Technol.* 60 (1): 29-34.
- [7] Bourne, M.C. (1978). Texture profile analysis. *J. of Food Sci.* 32: 62-67.
- [8] Snedecor, G.W. and Cochran, W.G. (1989). *Statistical Methods*. 8th edn. Iowa State University Press, Ames, Iowa.
- [9] Howsam, S. (1976). Better Texture for Vegetable Protein Foods. *Food Engineering International* 4 (2): 65-78
- [10] Lawson, M.A. (1993). Food proteins: properties, functionality and utilization. Ingredient Technology Short Course. Annual Meeting of the Inst. of food Technologists, Chicago, Ill., July 9, 1993.
- [11] Harper, J.M. (1981). "Extrusion of Foods," Vol II. CRC Press, Boca Raton FL.
- [12] Spicer, A. (1971). Meat analogues and other meat substitutes. *IFST-Proceedings*, 4 (3): 174-176
- [13] Tombs, M.P. (1974). The significance of meat analogues. In Meat: Proceeding of the 21st Easter School of Agricultural Sciences, University of Nottingham, edn: Cole and Lawrie. Pubs Butterworth. Pp: 525-534.
- [14] Malleshi, N.G. and Desikachar, H.S.R. (1982). Formulation of a weaning food with low hot paste viscosity based on malted ragi green gram. *J. Food Sci. Tech.* 19: 193-197
- [15] Anon. (1981). Fungus-based food tastes like meat. *Food Engineering International* 6 (9): 69-70.
- [16] Newmark, P. (1980). Meat substitutes fungal food. *Nature U.K.* 287 (5777): 6, XP000647700.
- [17] Chevrolet, G. (1988). Food composition for use in preparation or decoration of meats and similar products. *European Patent No- CH 83-6819 (831221)*.
- [18] Sung, G.K., Youn, K.R., Young, M.H., Jung, U.H. and Seung, C.L. (2001). Quality properties of fish meat paste containing enoki mushroom (*Flammulina velutipes*). *J. Korean Society of Food Sci. and Nutri.* 30 (2): 288-291.
- [19] Maurice, T.J., Burgess, L.D. and Stanley, D.W. (1976). Texture-structure relationships in texturized soy protein. III. Textural evaluation of extruded products. *Can Inst. Food Sci. Technol. J.* 9: 173-176.



- [20] Breene, W.M. and Barker, T.G. (1975). Development and application of texture measurement procedure for textured vegetable protein. *J. Text. Studies*,6: 459-472.
- [21] Loh, J. and Breene, W.M. (1977). Texture analysis of textured soy protein products: Correlation between instrumental measurement and sensory evaluation. *J. Text. Studies*,7: 405-419.
- [22] Bridget, O.O. and Sanusi, B.P. (2005). Soaking and cooking of soybean for soy-daddawa production: Bacterial profile and proximate composition. *J. Food Technol.* 3 (1): 87-91.
- [23] Giese, J. (1994). Proteins as ingredients: Types, functions and applications. *Food Technol.*48 (10): 50-60.
- [24] Kibler, L.A., Kratky, Z. and Tandy, J.S. (1988). Mushroom flavor. *European-Patent-Application EP 0 288 773 A2 (EP0288773A2)*.
- [25] Uzunov, G and Colova, L. (1972) Mushrooms as raw material for sausage production. *Tehnologija Mesa.* 13 (6): 162-165.
- [26] Caglarırmak, N. (2007). The nutrients of exotic mushrooms (*Lentinula edodes* and *Pleurotus* species) and an estimated approach to the volatile compounds. *Food Technol. Manisa*.52(9): 162-165.

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