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RESEARCH ARTICLE

INCORPORATION OF CHICKEN MEAT IN RICE FLOUR BASED NOODLES AND ITS EFFECTS ON PHYSICOCHEMICAL AND SENSORY QUALITIES

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ABSTRACT

The study was intended at optimizing the basic formulation and processing conditions for the preparation of chicken *meat noodle* with rice flour. Lean chicken meat in percent of 0 (control), 30, 40 and 50 percent were used in formulations. *Noodle* were evaluated for physico-chemical and sensory properties. Results showed that noodles containing 50 percent chicken meat was optimum for formulation of extended chicken *meat noodles.* The pH and emulsion stability of various emulsions revealed decreasing trend significantly ($P<0.05$) for pH and none significantly ($P>0.05$) for emulsion stability with increase in level of meat. The values for moisture, protein, fat, ash and water absorption index increased significantly ($P<0.05$) with increase in level of meat in noodles. The other parameters like crude fibre, yield, water solubility index, weight increase, volume increase and cooking loss decreased significantly ($P<0.05$) on increase in level of meat in noodles from 0 to 50 percent.

INTRODUCTION

Noodles are ancient food stuffs which could be defined as a type of dough extruded or stamped in to various shapes for cooking. Recently, research in the field of manufacturing and processing of these products eliminates the need of cooking for a very long period of time (1). There are variety of noodles available in the market some of them are precooked, dried and commercially packed and needs to be cooked in boiling water for a few minutes prior to consumption (2). Rice is the predominant staple food for 17 countries in Asia and the Pacific, nine countries in North and South America and eight countries in Africa. Rice provides 20 percent of the world's dietary energy supply, while wheat supplies 19 percent and maize 5 percent. In addition to being a rich source of dietary energy, rice is a good source of thiamine, riboflavin and niacin. Unmilled rice contains a significant amount of dietary fibre. The amino acid profile of rice shows that it is high in glutamic and aspartic acid, while lysine is the limiting amino acid.

Rice alone cannot supply all of the nutrients necessary for adequate nutrition. Rice flour is more valuable than wheat flour or soy in items of certain amino-acids such as phenylalanine, leucine and isoleucine (3). Rice flour could be used successfully in comminuted meat products for improving texture, flavour and colour of products. (4) Suggested that rice flour was more economical than soy flour in meat substitution. Rice is relatively free from toxic substances and PER ratio (ratio of weight grain to protein consumed on a 10% protein diet) of rice (2.18) is almost equivalent to that of beef (2.30) (5). Studies have also been carried out on the extrusion properties of corn, soy, wheat and rice in the production of snack foods (6, 7, 8, 9, 10). Various enriched noodles with different compounds are available in market especially in Asian food market (11) and lot of scope also exist for fortification of noodles/vermicelli with minerals, vitamins and proteins from other vegetable sources like pulses, groundnut, soybean and meat. Protein is essential for maintenance and regulation of the human body functions. It is also essential for body building, as a regulatory substance, to replace the damaged tissue and protect the body from microbes and diseases. In addition, the protein can also be used as a source of energy (calories). Besides, the protein can also function as enzymes, acts as plasma (albumin), and antibodies form complexes with other molecules, and as part of the muscles tissue (12). The possible utilization of chicken meat in noodle will not only increase the nutritive value of noodles but will certainly provide the poultry industry of India and world an alternate sector for value addition of chicken meat. Although a lot of work has been done to improve the functional properties and nutritive value of noodles through changes in formulations and processing; possibility of incorporation of meat in noodles as a source of protein remains almost unexplored.

MATERIAL AND METHODS

Source of chicken meat

The broilers chicken were procured from poultry farm of DUVASU, MATHURA and slaughtered as per standard

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procedure in the experimental slaughterhouse of Department of Livestock Products Technology, College of Veterinary Science and animal husbandry, Mathura, Utter Pradesh. The dressed broilers chicken carcasses were brought to the laboratory and hot deboned manually. After removal of all separable connective tissues, fat, fascia and blood vessels the deboned chicken meat (DCM) was packed in low density polyethylene (LDPE) bags and stored over night at 4 ± 1^0C in a refrigerator for conditioning and then frozen at -18 ± 1^0C for subsequent use. Frozen meat samples were taken out as per requirement and cut into smaller cubes after partial thawing in a refrigerator (4 ± 1^0C). The meat chunks were then double minced using 6 mm and 4 mm grinder plates to get fine minced chicken meat (MCM) for experimental use.

Salt

The salt used in the study was Sodium chloride (NaCl), Tata salt food grade was procured from local market Mathura, India.

Mono sodium glutamate

The Mono sodium L- glutamate LR of S.D. Fine chemicals limited, was used in the preparation of spices to improve the flavour of products.

Starch corn

The starch corn use in this experiment was of analytical grade and procured from Hi Media laboratories (P) Ltd, Mumbai.

Rice flour (RF)

The excellent quality rice (Brand - Basmati rice) was purchased from local market of Mathura, Utter Pradesh then kept it for drying at 65^0C in a hot air oven for about 2-3 hrs. After drying, it was grounded in a flour mill to obtain rice flour.

Taste maker

The taste maker formula used for addition in noodles contained anise (soanf-4%), black pepper (kali mirch-2%), turmeric powder (1%), Capsicum (Mirch powder 3%), Nutmeg (jaiphal 0.2%), Cardamom dry (Chhoti elaichi 1%), Fenugreek (0.3%), clove (loang-0.2%), Coriander (Dhania 5%), Cumin seeds (Zeera 4%), Ginger (3%), Garlic (3%), Onion (25%), Sugar 3%), Salt (2%), starch (24.8%), carrot (18%) and Monosodium glutamate (0.5%). These ingredients were procured from local market of Mathura, Utter Pradesh, and India. After removal of extraneous matters the ingredients were oven dried at 55±2°C for 3 hrs. While the onion, garlic ginger and carrot were peeled off and then cut in to the small pieces for suitable to drying in the microwave LG® at frequency 720 MHz for mhz for 2.5 min. one side then turn it and further kept for 2.5 min again at same frequency. After they were taken out from micro oven and were kept in to the hot air oven at 60 ± 5^0C for sufficient time such that they may be easily pulverised. The ingredients were ground mechanically in Inalsa food mixer and sieved through a fine (U.S.S. #30) mesh screen. The powders so obtained were mixed in suitable proportion to obtain a taste maker for chicken meat noodles. The taste maker was then immediately packed in presterilized LDPE bags (low density polyethylene) for subsequent use.

Methodology of preparation of *chicken meat noodle*

The prepared dough was extruded through the manually operated stainless steel extruder into rounded shape in tray. The trays were kept in a hot air oven (SciTech) at 65 ± 2^0C for required time (7-8 hours) for drying of chicken meat noodle. The dry and cool chicken noodles were manually broken into 10-15 cm long to obtain chicken meat noodles. Then chicken meat noodles were packed and sealed with the help of a sealer (Singhal®, HSP-200, and India) in presterilised LDPE. The LDPE bags containing chicken meat noodles were kept at ambient temperature for the further analysis of different physico-chemical parameters (pH, cooking yield percentage, water absorption index and water solubility index) and sensory characteristics (colour and appearance, flavor, texture, mouth-coating, meat flavor intensity, saltiness and overall palatability) to determine optimum level of meat in different group of flour. Aliquots of raw emulsions (dough) from various treatments under each trial of an experiment were collected in LDPE for analysis. The various ingredient used in the formulation of the chicken *meat noodles* are presented in the table 1.

Table 1. Formulation of rice flour based chicken meat noodles

Ingredients (%)	Control	T_1	T_2	T_3
MCM	00	27.0	36.0	45.0
Salt	2.0	2.0	2.0	2.0
Rice flour	90	63.0	54.0	45.0
Starch corn	08	08	08	08
Water requirement	54.754	25.279	13.852	4.474
Cooking time (min.)	6.833	7.833	10.00	11.583

Analytical procedures

The pH of meat emulsion (dough) and chicken meat noodle were determined (13) by blending 10 g of sample with 100 ml distilled water for 1 min. using pestle and mortar. The pH of the suspension was recorded by dipping combined glass electrode of an Elico pH meter (Model: LI 127). The yield of cooked emulsion mass was recorded as emulsion stability percent by the method as described by (14). Moisture, fat, protein and ash percentage of the product were estimated as per (15). The percent crude fibre in noodles was calculated by using the procedure of (16). The weight of chicken meat noodles was recorded before and after drying and the difference was calculated and expressed as percentage. Water absorption index was determined in accordance with method described by (17). Cooking loss was evaluated according to method of (18). 25 g noodle was cooked in boiling water (250 ml) on the basis of their optimum cooking time. Volume increase was measured according to method of (18). Weight increase was measured according to (18). Optimum cooking time of noodles was measured according to method of (19).

Sensory evaluation

The sensory qualities of samples were evaluated using 8 point descriptive scale (20) by sensory semi trained panellists of nine judges to evaluate the sensory qualities of chicken meat noodle. The evaluation was based on sensory characteristics (colour and appearance, flavour, texture, mouthcoating,

saltiness, meat flavour intensity and overall palatability) to determine optimum level of meat in the rice based noodles.

Statistical analysis

Data were analysed statistically on 'SPSS-16.0' software package as per standard methods **(**21**)**. Duplicate samples were drawn for each parameter and the experiment was replicated thrice (n=6). Sensory evaluation was performed by a panel of six member judges three times, so total observations being 18 (n=18).) Data were subjected to one way analysis of variance and level of significance among the treatments.

RESULTS AND DISCUSSION

The mean values of various parameters namely pH, emulsion stability, physico-chemical characteristics and sensory scores of chicken meat noodles prepared from rice flour having 0, 30, 40 and 50% levels chicken meat are presented in Table-2, 3 and 4.

pH and Emulsion stability of rice flour based chicken meat noodles

The emulsion prepared from rice flour and various levels of meat (0, 30, 40 and 50%) was assessed for pH and emulsion stability. The emulsion prepared from rice flour in combination with different levels of chicken meat and other ingredients showed the pH values in the range of 6.365±0.013 to 7.018±0.018. Replacement of flour with different levels of minced chicken meat (0, 30, 40, and 50%) showed the decreasing trend of pH with the increase in amount of the meat in meat emulsions. The decline in pH with increased meat contents was due to the acidic nature of chicken meat. This finding was very well agreed with the reports of (22) on fish noodles, (23) in duck meat sausages supplemented with cereal flours and (24) who incorporated surimi powder in wet yellow noodles preparation.

The values obtained from the emulsions prepared with rice flour and different levels of chicken meat (0, 30, 40 and 50 percent) combinations showed significant (P<0.05) difference among each other with exceptions of 40 and 50 percent meat level emulsions. However, the emulsion stability of emulsion prepared from rice flour in combination with various levels of chicken meat and other ingredients was in the range of 97.899±0.262 to 98.260±0.234.The overall mean values of emulsion stability were in decreasing trend with the increase in level of meat from 0 to 50 percent. This finding was very well agreed with the results of (25, 26, 27). Who stated that emulsion stability of chicken snack containing 60% chicken meat to be 93.91% which was found to be lowest among all the treatments. Analysis of the variance of data on emulsion stability showed none significant difference of meat level on the emulsion stability values.

Table 2. pHand emulsion stability parameters of rice flour based chicken meat emulsion (mean±sem)

Parameter	Level of chicken meat (%)			
	0	30	40	50
pH of dough	7.018^{c}±0.018	6.468^{b}±0.0095	6.407^{a}±0.017	6.365^{a}±0.013
Emulsion stability (%)	98.260±0.234	98.201±0.203	97.990±0.267	97.899±0.262

Superscript row wise differ significantly (P<0.05)

Physico-chemical properties of rice flour based chicken meat noodles

The data obtained for various physico-chemical properties i.e. moisture, fat, protein, ash, crude fibre, yield, water absorption index (WAI), water solubility index (WSI), weight increase, volume increase, and cooking loss of chicken meat and control noodles. The mean values of moisture, protein, fat, ash , crude fibre, yield, water absorption index (WAI), water solubility index (WSI), weight increase, volume increase and cooking loss were 9.319±0.026 to 9.489±0.049, 9.854±0.415 to 26.526±0.525, 2.436±0.133 to 4.970±0.080, 2.535±0.054 to 3.798±0.041, 1.689±0.026 to 0.811±0.010, 50.994±0.729 to 61.861±0.414, 1.791±0.034 to 2.357±0.039, 0.048±0.002 to 0.072±0.0007, 3.296±0.080 to 3.784±0.061, 233.126±6.709 to 331.732±7.178 and 9.813±0.215to 11.768±0.320 respectively.

The mean values of proximate composition such as (moisture, protein, fat, and ash) and water absorption index increased as the replacement of flour with meat were increased. However the mean values of crud fiber, yield, water solubility index, weight increase, volume increase and cooking loss showed decreasing trend with the increase in amount of meat in chicken meat noodles. Rice flour based chicken meat noodles was found significantly (P<0.05) different in comparison to the noodles containing various levels of meat (0 i.e. control, 30 and 40 percent). The moisture content of noodles containing 0, 30 and 40 percent meat showed none significant difference (P>0.05) among all three treatments in rice flour based chicken meat noodles. Whereas in protein increasing trends were observed in rice flour based chicken meat noodles with increase in the quantity of meat in the chicken meat noodles. The contents of proteins were significantly (P<0.05) different rice flour based chicken meat noodles with respect to the increase in level of meat from 0 to 50 percent. The mean values of fat also observed increased in rice flour based chicken meat noodles with increase in the quantity of meat. The overall significance showed that the contents of fat were significantly (P<0.05) different in each and every combinations of rice flour and level of meat (0, 30, 40 and 50 percent).

Ash contents in rice based chicken meat noodle were in increasing trend with increase in contents of meat. However, the contents of ash in rice based noodles showed significant (P<0.05) difference among the 0 to 50 percent level of meat. The contents of crude fiber were significantly (P<0.05) different in all of the noodles prepared from rice flour and chicken meat. The decreasing trends of yield were recorded with increase in the meat level in the rice flour based chicken meat noodles. The yield of rice flour based chicken meat noodles were made from 0 and 30 percent of meat were none significantly (P>0.05) different among each other but these values were significantly (P<0.05) different from rest of the meat levels. The WAI values of rice flour based chicken meat noodles where increasing trends was observed on enhancement in meat levels. . The water absorption index (WAI) values at 30 and 40 percent meat levels were non significantly (P>0.05) different from each other rice flour based chicken meat noodles but these values were significantly (P<0.05) different from the WAI values of the noodles made from 0 and 50 percent level of meat. The values of noodles at 0 and 50 percent level of meat noodles were also significantly (P<0.05) different among each other. Decreasing

Trends in the WSI value of the rice flour based chicken meat noodles with increase in the amount of meat in variety of noodle preparations. The values of WSI were none significantly (P>0.05) different between 0 and 30 percent meat level of noodles whereas these values were significantly (P<0.05) different from the values obtained at 40 and 50 percent chicken meat noodles. The decreasing trend was observed in weight increase of rice flour chicken meat noodle with increase in level of meat. Weight increase values of rice flour chicken meat noodles at 0 and 50 percent meat level was significantly (P<0.05) different from rest of the values of various meat level products and also among each other. Whereas 30 percent meat level product was none significantly (P>0.05) different from 40 percent meat level and same was in 50 and 40 meat level meat noodle prepared from rice flour.

The decreasing trend was recorded in volume increase of rice flour chicken meat noodle with increase in level of meat. Rice flour based chicken meat noodles were significantly (P<0.05) different among the various levels of meat noodles. Cooking loss in chicken noodles prepared from rice flour containing meat level 0, 30, 40 and 50 percent in general showed decreasing trend with increase in level of meat used. The level of significance on cooking loss in rice flour based chicken meat noodle showed none significance (P>0.05) difference among 0 and 30 percent meat level noodles and also in 40 and 50 percent meat level noodles. However, cooking loss values at 0 and 30 percent level of meat were significantly different (P<0.05) from the values observed at 40 and 50 percent level of meat products. The increased moisture percent with increase in meat level might be due to high moisture contents in chicken meat as compared to the flour used. This finding was in agreed of the reports given by (28) on functionality of proteins in food. Replacement of flours with different levels of chicken meat (0, 30, 40 and 50) had significant effect (P<0.05) on protein content of chicken meat noodles. (29) also found highly significant (P<0.01) difference in protein content in chicken meat stick and found that there was increase in protein content while increase in incorporation of meat in chicken meat stick. Similar trend of increased protein contents with increase in fish meat in fish noodles was also reported by (22) and (30) on dried noodles incorporated with surimi.

The overall mean contents of fat were in the increasing order with the increase level of meat in rice flour based chicken meat noodles which might be due to higher contents of fat in chicken meat in comparison to the flours used. (31) also found increase in fat content with increase in meat replacement during the preparation of chicken meat noodles. Similar finding was reported by the (32) in case of noodles prepared from by using apricot kernel flour. The increased ash contents with increased level of meat might be due to the higher contents of minerals in meat as compared to rice flour. The significant (P<0.05) effect on ash contents was also observed by the (24) in surimi based wet yellow noodles, similar finding was reported by the (33) on addition of whey protein concentrate and skim milk powder in the noodles and (32) in apricot kernel flour based noodles. The same trend was noticed by (34) in reduction of rice flour level in preparation of breads. The decreased crude fibre contents with increase in meat level might be due to higher crude fibres in grains flours as compared to food of animal sources. The findings were very well supported by the findings of (35) on the use of various flours in pasta preparation. These finding was agreed with the (33) addition of whey protein concentrate and skim milk powder in the noodles. The overall mean values of the yield observed decreasing trend with the enhancement of meat level that might be due to the increase in moisture contents in the products. So the loss of moisture in highest meat level product may be higher than that of rest of the products. The overall mean weight decreased among all types and levels of meat showed lowest value in products containing 50 percent meat. (36) also reported decreased cooking yield with increase in meat level during preparation of chicken meat snacks. The present study was also in agreement of (37) who concluded that cooking yield of chips prepared by taking 95% chicken meat was lesser than other formulations containing lower meat percentage. The overall mean values of the chicken meat and control noodles prepared from rice flour with various meat levels (0 to 50%) showed decreased volume increase values. The reason may be increase in protein and moisture contents with increase in level of meat and decrease in contents of carbohydrates.

These findings were in the order of (32) reports on volume increase of noodles prepared with apricot kernel flour. The overall means values of water absorption index (WAI) were increased in rice flour chicken meat noodle with increase in incorporation of meat levels. This might be due to increase in content of protein with incorporation of meat the increased WAI in other types of noodles was supported by (32) study on extruded fish cracker snacks. The overall means values of water solubility index (WSI) were decreased in rice flour chicken meat noodle with increase in incorporation of meat levels. The decreased WSI with the increase in meat level might be due to degradation of starch during extrusion with these flours and less binding properties with meat (38). Cooking loss is unlikable and according to (39) it should not more than 10% of the dry weight. According to Croatian Official Regulation, cooking loss should $\geq$ 12%. The significantly lowest value of the cooking loss occurred with sample having 50% chicken meat, and the highest with sample control. The decrease in the cooking loss might be due to the formation of strong protein and starch network configuration. (40) reported the cooking loss could be attributed to feeble protein-starch interaction and/or destroyed protein matrix.

Table 3. Physico chemical parameters of rice flour based chicken meat noodles (mean±sem)

Parameter	Level of chicken meat (%)			
	0	30	40	50
Moisture (%)	9.319^{a}±0.026	9.386^{ab}±0.031	9.44^{bc}±0.051	9.489^{c}±0.049
Ash (%)	2.535^{a}±0.054	3.063^{b}±0.066	3.463^{c}±0.159	3.798^{d}±0.041
Protein (%)	9.854^{a}±0.415	16.898^{b}±0.397	21.993^{c}±0.716	26.526^{d}±0.525
Crude fibre (%)	1.689^{a}±0.026	1.431^{b}±0.021	1.252^{c}±0.0309	0.811^{d}±0.010
Fat (%)	2.436^{a}±0.133	3.592^{b}±0.131	3.961^{c}±0.113	4.970^{d}±0.080
Yield (%)	61.861^{a}±0.414	61.581^{a}±0.377	55.803^{b}±0.514	50.994^{c}±0.729
Water absorption index (g/g)	1.791^{a}±0.034	2.030^{b}±0.063	2.097^{b}±0.083	2.357^{c}±0.039
Water solubility index (%)	0.072^{a}±0.0007	0.071^{a}±0.0004	0.056^{b}±0.003	0.048^{b}±0.002
Weight increase (%)	3.784^{a}±0.061	3.675^{b}±0.064	3.457^{bc}±0.098	3.296^{c}±0.080
Volume increase (%)	331.732^{a}±7.178	294.531^{b}±5.96	265.253^{b}±5.606	233.126^{c}±6.709
Cooking loss (%)	11.768^{a}±0.320	11.215^{a}±0.198	9.90^{b}±0.287	9.813^{b}±0.215

Superscript row wise differ significantly (P<0.05)

Sensory evaluation of Rice flour based chicken meat noodles

The chicken meat noodles prepared from rice flour and various levels 0, 30, 40 and 50 percent of minced chicken meat were assessed by the semi trained judges for colour and appearance, flavour, texture, mouth coating, saltiness, meat flavour intensity and over all acceptability scores. On the

basis of evaluation of sensory scores it was noticed that all developed products were very well accepted by the judges. The scores obtained on hedonic scale showed minimum values for control and maximum for 50 percent meat level products. The sensory scores found to be within the range were 4.703±0.089 to 6.629±0.161, 4.851±.0.224 to 6.481±0.202, 4.777±0.163 to 6.629±0.193, 4.703±0.231 to 6.666±0.177, 4.000±0.220 to 6.481±0.195, 4.814±0.232 to 6.666±0.206 and 4.925±0.213 to 6.703±0.198 for colour and appearance, flavour, texture, mouth coating, saltiness, meat flavour intensity and overall acceptability respectively. The level of significance (P>0.05) showed that the score for colour and appearance, flavour, texture, mouth coating and overall acceptability for the products containing 0 and 30 percent meat were non significantly different (P>0.05) among the levels of meat while these values were significantly (P<0.05) different from 40 and 50 percent meat level products in context with colour and appearance, flavour, texture, mouth coating and overall acceptability scores. These scores for 40 and 50 percent meat levels were also significantly (P<0.05) different among the levels of meat products. The saltiness and meat flavour intensity showed significant (P<0.05) difference with all levels of meat in rice flour based chicken meat noodles. This result was in agreement with the observations made by (41). (42) confirm that on incorporation of small quantity of milk protein enhanced the organoleptic properties of the extruded products.

Table 4. Sensory scores of rice flour based chicken meat noodles (mean±sem)

Parameter	Level of chicken meat in (%)			
	0	30	40	50
Appearance and colour	4.703^{a}±0.089	4.925^{a}±0.213	5.666^{b}±0.177	6.629^{c}±0.161
Flavour	4.851^{a}±0.224	4.963^{a}±0.112	5.888^{b}±0.171	6.481^{c}±0.202
Texture	4.777^{a}±0.163	$4.85±^{a}$0.127	5.888^{b}±0.134	6.629^{c}±0.193
Mouth coating	4.703^{a}±0.231	$5.148±^{a}$0.127	5.777^{b}±0.097	6.666^{c}±0.177
Saltiness	4.000^{a}±0.220	4.703^{b}±0.175	5.777^{c}±0.134	6.481^{d}±0.195
Meat flavour intensity	0^{a}±0	4.814^{b}±0.232	6.037^{c}±0.172	6.666^{d}±0.206
Overall acceptability	4.925^{a}±0.213	5.111^{A}±0.144	6.03^{b}±0.146	6.703^{c}±0.198

Superscript row wise differ significantly (P<0.05)

Conclusion

The incorporation of chicken meat had an impact on the physicochemical and sensory properties of noodles. The incorporation of chicken meat significantly increased (P<0.05) in the ash, protein, fat, moisture and water absorption index as the levels of chicken meat increased. However, they had significantly decreased (P<0.05) crud fiber, pH, water solubility index, weight increase, volume increase, yield and cooking loss. However, emulsion stability decreased none (P>0.05) significantly as the level of meat incorporation increased from 0 to 50 %. The sensory evaluation results showed there were increased in all parameter with the increasing incorporation of chicken meat upto 50% chicken meat incorporation. So noodles having 50 % chicken meat represented an acceptable preference in term of sensory evaluation based on all individual and overall sensory attributes compare than 0, 30, and 40 %. In conclusion, this study provides useful functional information for the future development of functional chicken meat -based noodles products and study of whole storage self life.

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