Quality Evaluation of Functional Chicken Nuggets Incorporated with Ground Carrot and Mashed Sweet Potato

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This study was envisaged to evaluate the effect of ground raw carrot (0%, 5%, 10% and 15%) and mashed sweet potato (0%, 5%, 10% and 15%) as functional ingredients on the quality of chicken meat nuggets. The products were evaluated for physicochemical quality, proximate composition, nutritive value, sensory quality as well as color and texture profile analyses. Additions of either raw carrot or mashed sweet potato represent an improvement in the nutritional value and have some beneficial effects due to the presence of dietary fibers and β-carotene. They were also found to be effective in sustaining the desired cooking yield and emulsion stability. Treated samples showed lower ($p > 0.05$) protein, fat and ash contents but higher ($p < 0.05$) moisture content than control. There were differences among the nugget samples with respect to sensory qualities, and control samples as well as samples with 10% added carrot/sweet potato had higher overall acceptability scores. Hunter color values (L^*, a^* and b^* values) were higher ($p < 0.05$) for both the formulated products, while their textural parameters were nearly unchanged. In conclusion, carrot and sweet potato at 10% added level have greater potential as good source of dietary fibers and β-carotene and may find their way in meat industry.

Key Words: chicken meat nuggets, carrot, sweet potato, dietary fiber, β-carotene, color, texture

INTRODUCTION

Fat in diet contributes diverse functional, nutritional and physiological benefits. Fat plays a major role in flavor development, texture of the foods and also increases the felling of satiety during a meal. Fat modifies the perception of flavors by influencing balance intensity, their distribution and migration (Viuda-Martos et al., 2010). In terms of texture, fat exerts considerable influence on the binding, rheological and structural properties in comminuted meat products. Besides playing a functional role, it is a rich source of fat-soluble vitamins and essential fatty acids, and constitutes the most concentrated source of dietary energy (Turhan et al., 2005). However, high intake of total dietary fat is associated with increased risk of obesity, some types of cancers, hypercholesterolemia, coronary heart diseases, etc., and for this, several health organizations set the limit that the intake of total dietary fat should not be more than 30% of the total calories (Giese, 1996).

The reduction of fat in meat products, however, poses newer challenges as leaner meat produces products with firmer texture, which are drier, less succulent and less tasty than standard products (Crehan et al., 2000). To offset this detrimental effect, manufacturer have introduced several useful modifications, and among these, uses of vegetables as a non-meat ingredient is one of the better options as it conveyed desirable texture, enhanced water-binding capacity, reduced cost of the production and improved nutritional value (Serdaroglu et al., 2005; Choi et al., 2007; Clough, 2008; Eim et al., 2008; Vuyst et al., 2008; Wang, 2009; Viuda-Martos et al., 2010). The diet prevailing in many industrialized countries is characterized by an excess of energy-dense food rich in fat, but with a deficiency of complex carbohydrates which constitute major portion of dietary fiber (DF; Fernandez-Gines et al., 2004). Inclusion of carrot and sweet potato in new products or existing ones may solve the current fiber deficit to the consumers, and help to reduce the risk of colon cancer, obesity, cardiovascular diseases and several other disorders. As food additives, they could also help to retard lipid per-oxidation

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process besides their inherent functional properties (Tungland and Meyer, 2002).

Raw carrots (RCs) and sweet potatoes are rich in DFs, vitamins and carotenoids. They have potent antioxidant activity mainly due to the presence of vitamins C and E, β-carotene and flavonoids (Eberhardt et al., 2000). Flavonoids are effective antioxidants because of their scavenging properties against free oxygen radicals, metal chelators and lipid peroxidation process (Charoensiri et al., 2009). According to Eim et al. (2008), sobrassada with 3% added carrot had higher acceptability for various physicochemical and sensory parameters but its textural parameters were significantly affected. The lipolytic process was only affected when relatively large percentages of DF concentrate were incorporated. Saleh and Ahmed (1998) reported that color, yield, texture and vitamin A content of beef patties were improved by the addition of boiled carrot and sweet potato. Nitsch (2003) reported that addition of carrot fiber could significantly reduced jelly separation of canned meat products, thus achieving a reduction of water loss. In comminuted meat products like meatballs, addition of 3% carrot fiber was possible without impairment of sensory properties.

To the best of our knowledge, there are limited reports on the use of RC and mashed sweet potato (MSP) as functional ingredients in chicken meat products. Therefore, our objectives were to evaluate the effects of different levels of RC and MSP on physicochemical characteristics, nutritional value, color, texture and sensory qualities of chicken nuggets.

MATERIALS AND METHODS

Preparation of Carrot Paste and MSP

The carrots and sweet potatoes purchased from local market were washed and cleaned properly with tap water. In the case of carrots, the outer most thin layer and the central white portion were removed and the remaining portions were sliced. The components so obtained were then ground into a spice grinder until a fine paste was obtained. The cleaned and washed sweet potatoes were boiled for 5 min, cooled to room temperature, and then peeled off and mashed to obtain a fine paste. Both the components were packed in low-density polyethylene (LDPE) bags and stored at refrigeration temperature till use.

Methods

Mincing of Meat and Preparation of Chicken Meat Nuggets

The spent male birds of broiler parent stock (IBL-98), 32 weeks of age were slaughtered in the departmental slaughterhouse as per standard method. The dressed carcasses were chilled (4 ± 1 °C) overnight, deboned manually and then divided into small cubes ($5 \times 5 \times 5\,cm^3$). The meat cubes were then first ground through a 6-mm grinding plate followed by a 4 mm plate in a motor-driven meat mincer (Kalsi Motors, Ludhiana, India). Chicken nuggets were manufactured according to standard formula (the percentages of all the ingredients are related to meat emulsion): 77.5% lean chicken meat (w/w), 4% refined wheat flour (w/w), 5% refined vegetable oil (w/w), 5% textured soy protein (w/w), 3% condiment (w/w), 3% whole egg liquid (WEL; w/w), 1.6% sodium chloride (w/w), 1.75% spice mix (w/w), 0.5% sugar (w/w), 0.2% tetra-sodium pyrophosphate (w/w) and 120 mg/kg sodium nitrite. Two experiments were conducted. In experiment 1, ground RC was used while other experiment contained MSP. In both the experiments, the original mixture was used as the control sample. RC and MSP were added in treated samples at 5%, 10% and 15% levels with replacement of lean meat. All batches of minced meat samples were mixed separately with the other ingredients in an Inalsa food blender for 1 min. Salt and TSPP were added first and WEL and refined vegetable oil were slowly added at the time of mixing in Inalsa mixer. Other ingredients were also added simultaneously. After complete mixing, emulsions were taken out to prepare chicken meat nuggets. Carrot and sweet potato added samples did not contain added sugar.

The meat emulsions prepared using the above formulations were filled up in rectangular-shaped aluminum molds. The filled up molds were placed in an autoclave and cooked at 15 lb pressure, 121 °C temperature for 20 min. The cooked samples were cooled to room temperature, packed in colorless LDPE bags (150–200 gages), sealed and then kept at 4 ± 1 °C temperature before being sliced into nuggets and subjected to subsequent quality evaluation.

Physicochemical Analysis and Nutritive Value

Emulsion stability of nuggets was determined following the method of Baliga and Madaiah (1970), and pH was measured (Devatkal and Naveena, 2010) in homogenates prepared with 10 g of sample and distilled water (50 mL), using an Elico pH meter (Model: LI 127). The cooking yield was determined after recording the weight of emulsion before and after cooking, and expressed as percentage. Moisture (gravimetric method), protein (Kjeldhal nitrogen), fat (Sohxlet method), total ash (muffle furnace) and crude fibers were determined following the AOAC (2007) procedures. The β-carotene content was determined as per methodology mentioned by Qin et al. (2008). Total calorie estimates (kcal) were determined on the basis of 100 g sample using Atwater values for fat (9 kcal/g), protein (4.02 kcal/g) and carbohydrate (3.87 kcal/g) (Mansour and Khalil, 1997). The amount of carbohydrate for energy estimates was calculated on the basis of product formulations and the composition of added ingredients. The energy value of DF was considered as per European legislation act using a conversion factor of 2 kcal/g of fiber (European Commission, 2010). All analyses were performed in duplicate.

Color Profile Analysis

Color profile was measured using Hunter Colour Lab (Mini XE, Portable type) having a setting of cool white light (D_{65}) and 2° was used to measure Hunter L^*, a^* and b^* values. Hunter L^* value denotes (brightness100) or lightness (0), a^* (+ redness/− greenness), b^* (+ yellowness/− blueness) values were recorded on/in a thick slice of whole meat block. The instrument was calibrated using light trap/black glass and white tile provided with the instrument. Then, the above color parameters were selected. The instrument was directly put on the surface of meat product at three different points. Mean and standard error for each parameter were estimated.

Texture Profile Analysis

Texture profile analysis (TPA) was conducted using Texture analyzer (TA-HDi, Stable Microsystem, UK) at Central Institute of Post Harvest Engineering and Technology, PAU Campus, Ludhiana. Six slices of each sample of $1 \times 1 \times 1\,cm^3$ was subjected to pre-test speed (2 mm/s), post-test speed (5 mm/s) and test speed (1 mm/s) with a deformation of 3 mm, time (2 s) having a load cell of 500 N. A compression platform of 25 mm was used as a probe. The TPA was performed as per the procedure outlined by Rai and Balasubramanian (2009). The parameters determined from the force–time plot were Hardness (N) = maximum force required to compress the sample (second peak, F_2); Springiness (cm) calculated as the distance that the product recovered its height during the time that elapsed between the end of the first bite and the start of the second bite; Cohesiveness (A_2/A_1) measured as the ratio of the positive force area during the second compression (A_2) to the positive area during the first compression (A_1). Chewiness (N cm) calculated as hardness × cohesiveness × springiness; and resilience = the ratio of area of A_5/A_4.

Sensory Evaluation

Samples were evaluated by a seven-member experienced panel of judges comprising the faculty members and postgraduate students of College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India. A quantitative descriptive analysis was carried out for the attributes of appearance and color, texture, flavor, juiciness and overall acceptability using eight-point scale, where 8 = extremely desirable and 1 = extremely undesirable (Keeton, 1983). All sensory work was carried out in the sensory laboratory at the University, which fulfills the requirements according to the international standards. During evaluation, the panelists sat in private booths under incandescent light, with an intensity of approximately 440 lx. Rectangular pieces approximately $2.5 \times 2.5 \times 5\,cm^3$ were cut and served to the panel members. Tap water at room temperature was provided to cleanse the palate between samples. The tests were carried out 1 h before or 2 h after the midday meal. Three sittings ($n = 21$) were conducted at each time on samples warmed in a microwave oven for 20 s.

Statistical Analysis

Data were interpreted by analysis of variance with Duncan's multiple range tests on 'SPSS-12.0' software packages as per standard methods of (Snedecor and Cochran, 1994). Statistical significance was expressed at the 5% level.

RESULTS AND DISCUSSION

Physico-chemical Characteristics

It has been observed that the addition of RC and MSP in the nugget formulations significantly ($p < 0.05$) affected the pH of raw and cooked products (Table 1). The lowest pH was recorded in samples with 15% added RC and MSP. The decrease of pH could be attributed due to the fact that pH of vegetables added in the products is more acidic. As expected, slightly higher pH was observed in cooked samples, which would be due to denaturation of protein and thus releases of free amino groups, especially free –SH groups that occurred at higher temperature (Lawrie, 1998). In experiment 2, samples with MSP at 15% added level had lower ($p < 0.05$) pH than control. The decrease in pH value of samples with MSP could be due to the depolymerization of starch granules caused by the thermal treatment during boiling, resulting acid terminal residues in the starch molecules (Perez, 1997). On subsequent heating during product cooking, the starch molecules rarely undergo further depolymerization process.

The result of pH coincides with the finding of ES, as evident by the slight decrease in value with the addition of carrot paste. This might be due to the fact that level of proteins is not enough to retain so much amount of water with the added vegetables. Further, on cooking, RCs exudate more liquid in the meat batter and seem to have a negative influence on the water-binding effect (Anonymous, 2009). Lower cooking yield ($p > 0.05$) was also found in treated samples compared with control. This might be attributed due to lower pH of meat

Table 1. Effect of RC and MSP on physico-chemical quality of chicken meat nuggets.

Treatment	Emulsion pH	Product pH	Emulsion stability (%)	Cooking yield (%)
Experiment 1				
RC (0%)	6.05±0.10 c	6.20±0.09 b	98.77±0.48 b	98.97±0.28
RC (5%)	5.98±0.02 bc	6.07±0.01 ab	98.08±0.50 b	98.05±0.16
RC (10%)	5.86±0.02 ab	6.01±0.02 ab	96.82±0.53 ab	97.64±0.25
RC (15%)	5.84±0.04 a	5.99±0.03 a	95.54±0.57 a	96.43±0.15
Experiment 2				
MSP (0%)	6.00±0.03 c	6.07±0.02 b	98.89±0.14	98.88±0.31
MSP (5%)	5.89±0.01 bc	6.01±0.01 b	98.31±0.36	98.63±0.33
MSP (10%)	5.86±0.03 b	5.99±0.01 ab	97.28±0.77	98.14±0.34
MSP (15%)	5.70±0.02 a	5.92±0.03 a	96.64±0.10	97.42±0.53

Values (mean ± SE, $n = 6$) followed by different letters within column-wise differ significantly ($p < 0.05$).

Table 2. Effect of RC and MSP on chemical composition of chicken meat nuggets.

Treatment	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Crude fiber (%)	β-carotene (μg/g)	Energy values(Kcal)
Experiment 1							
RC (0%)	65.67±0.38 a	8.03±0.37	16.57±0.56	2.75±0.07	0.23±0.01 a	0.0	139.84
RC (5%)	65.95±0.85 ab	7.33±0.16	16.34±0.20	2.77±0.08	0.76±0.11 a	1.91±1.26 a	136.98
RC (10%)	66.26±0.49 ab	7.10±0.19	15.86±0.41	2.67±0.09	1.18±0.18 b	3.61±1.84 b	137.00
RC (15%)	66.80±0.44 b	6.78±0.08	15.51±0.38	2.71±0.14	1.65±0.11 c	5.23±1.09 c	135.56
Experiment 2							
MSP (0%)	62.82±0.66 a	9.25±0.51	16.95±0.39	3.73±0.04 b	0.15±0.10 a	0.0	152.27
MSP (5%)	63.37±0.28 a	8.79±0.33	16.81±0.53	3.66±0.12 ab	0.68±0.11 a	1.68±1.37 a	150.97
MSP (10%)	63.82±0.96 a	8.27±0.22	16.67±0.56	3.33±0.19 a	1.15±0.17 b	3.50±1.13 b	147.79
MSP (15%)	66.10±0.47 b	7.50±0.37	15.79±0.55	3.11±0.07 a	1.47±0.09 c	5.11±1.01 c	140.38

Values (mean ± SE, $n = 6$) followed by different letters within column-wise differ significantly ($p < 0.05$).

emulsion. These results are in agreement with the results obtained by Devatkal et al. (2004) who reported significant ($p < 0.05$) decrease in pH, emulsion stability and product yield in liver–vegetable loaves compared to control. Similar findings were also reported by Saleh and Ahmed (1998) in ground beef patties. Grigelmo-Miguel et al. (1999) reported addition of DF in meat product formulation lowered the pH (6.4–5.8) of the solution, thereby that of product pH. However, they again reported that DF was effective in retaining added water in low-fat frankfurters since their cooking losses were similar to those of the controls.

Proximate Composition and Nutritive Value

The difference in the composition of the different batches was only due to the amount and types of fiber added, since initial mixture for all batches was the same. The addition of RC and soy protein (SP) led to improvement in moisture content but decrease the protein (Table 2); however, fat and ash contents, compared with control, were significant ($p < 0.05$) at 15% added levels. Similar finding was also reported by Saleh and Ahmed (1998) regarding beef patties. In general, fat and moisture contents are very closely related in meat products, and if the fat content is low, the moisture content is likely to be high. Grigelmo-Miguel et al. (1999) reported higher water content in meat products incorporated with fruit fiber. This could be attributed due to the higher water retention capacity of these fibers, the soluble component of which is mainly pectin that may constitute up to 30% of the fiber concentrate. The β-carotene and crude fiber contents were higher for treated samples in any of the two experiments than control. This might be due to the modification of the compositions and fiber addition. However, the values for β-carotene content in treated samples were much lower than values found in RC and sweet potato (Table 3), which could be attributed to the degradation of β-carotene on heating during processing of products (Ferreira and Rodriguez-Amaya, 2008). The addition of these vegetables (at 10% level) could represent 350–360 μg of β-carotene per 100 g of fortified chicken nuggets, while that required at a level of 30 000 μg (5000 IU of vitamin A) is required per day per adult, as recommended by U.S. Food and Drug Administration (Woodson, 2010).

Control samples of both experiments 1 and 2 had the highest ($p < 0.05$) energy values (139.84 and 152.27 kcal/100 g), as compared to formulated products. The energy values for carrot-added samples were in between 136.98 and 135.56 kcal/100 g while those were

150.97–140.38 kcal for MSP-added samples. The formulations contained different levels of carrot and sweet potato paste did not affect the energy values of chicken nuggets. Comparatively, more energy values were noted in products from experiment 2 which could be attributed due to a higher level of carbohydrates in sweet potato (Table 3). However, in general, with respect to control samples, approximately 4–12% energy reduction could be possible with the addition of carrot and sweet potato. This was due to lower content of fats in treated samples, which are the most concentrated dietary energy source contributing 9 kcal/g, more than twice that provided by proteins and carbohydrates.

Sensory Evaluation

Sensory properties are major concerns for the utilization of vegetable-based ingredients in meat product development. The effect of RC and MSP on the appearance and color scores was significant only when they are added at higher level (Table 4). The samples with 15% added carrot and sweet potato showed comparatively lower ($p < 0.05\%$) appearance and color scores. The former one was due to a darker color shown by the carotenoid pigments, while latter one was due to the diluent effect of sweet potato on myoglobin concentration. However, appearance and color scores of samples from experiments 1 and 2 at same concentrations of carrot and sweet potato did not vary too much though they could not be compared statistically. Elgasim and Wesali (2000) reported similar findings when they added SP concentrate and Samh (*Mesembryanthemum forsskalei*) flour in ground beef patties. However, the color and appearance scores of formulated products with 10% added level were still rated higher and they were ranged in between very good to good.

Table 3. Nutritive value (per 100 g) of RC and sweet potato incorporated in development of chicken meat nuggets.

Parameter	RC	Sweet potato
Moisture (%)	87.7	75.2
Fat (%)	0.31	0.24
Protein (%)	1.08	1.62
Carbohydrate[a]	7.36	18.68
Ash (%)	1.16	1.45
Dietary fiber (%)	3.04	2.97
β-carotene (μg/100 g)	8234	8517
Energy (kcal/100 g))	35.61	80.96

[a]Estimated value (not determined).

The textural scores were the lowest ($p < 0.05$) for nuggets with 15% added MSP. Slightly lower textural scores for samples with MSP could be attributed to the lowering of protein content by reducing the meat level in the formulation which has a major impact on the texture-building effect by binding with water and forms gel on heating. So, adding vegetable fibers to a meat product might be beneficial to the texture if the fibers interact with the extracted myosin in the meat product (Anonymous, 2009). Textural changes in the products with the added level of carrot and sweet potato were also confirmed by instrumental texture analysis. Similarly, Eim et al. (2008) reported lower textural value of dry fermented sausages (Sobrassada) formulated with higher level of DF.

Pertaining to flavor intensity, control nuggets from both the experiments 1 and 2 showed highest scores than treated groups. Samples with 10% added carrot exhibited RC flavor, but in general, their taste was improved. This might be due to the sugar residues from carrots and amino acids and small peptides from the meat forms a Maillard reaction product upon heating, which gives the meat product a palatable taste. Addition of SP may have lessened the reduction of meat flavor intensity, but a substantial reduction of this value was noticed at 15% added level.

With regards to juiciness, products with added vegetables were less juicy at the first bite, had less moisture release during chewing and were drier after chewing than control samples. The control samples showed

Table 4. Effect of RC and MSP on sensory attributes of chicken meat nuggets.

Treatment	Color and appearance	Flavor	Texture	Juiciness	Overall acceptability
Experiment 1					
RC (0%)	7.17±0.08 b	7.19±0.07 b	7.10±0.07 b	7.19±0.09 b	7.19±0.09 b
RC (5%)	7.05±0.08 b	7.02±0.08 b	7.16±0.09 b	7.04±0.06 b	7.14±0.07 b
RC (10%)	7.20±0.11 b	7.05±0.10 b	7.03±0.08 ab	7.09±0.08 b	7.26±0.07 b
RC (15%)	6.80±0.11 a	6.75±0.17 a	6.98±0.18 a	6.87±0.12 a	6.81±0.10 a
Experiment 2					
MSP (0%)	7.14±0.05 b	7.21±0.10 b	7.21±0.05 b	7.36±0.06 b	7.21±0.07 b
MSP (5%)	7.11±0.07 b	7.09±0.06 b	7.19±0.05 b	7.27±0.05 b	7.00±0.05 b
MSP (10%)	7.26±0.05 b	6.98±0.08 a	6.95±0.04 a	7.14±0.05 b	7.25±0.05 b
MSP (15%)	6.59±0.13 a	6.71±0.11 a	6.55±0.15 a	6.50±0.15 a	6.59±0.10 a

Values (mean ± SE, $n = 21$) followed by different letters within column-wise differ significantly ($p < 0.05$). Scores based on eight-point descriptive scale, where 8 = extremely desirable and 1 = extremely undesirable.

highest juiciness scores, attributed to higher fat level, which was also reported (Devatkal and Naveena, 2010).

The overall acceptability scores of formulated nuggets samples just followed the mean values of other attributes; hence, the highest scores were recorded for control samples from both the experiments. As samples with carrot and sweet potato at 10% added levels exhibited comparable sensory scores to those of control, they were selected for color and TPA.

Hunter Color Values

Table 5 gives the results of the different color parameters such as lightness (L^*), redness (a^*) and yellowness (b^*) coordinates. The differences between lightness, redness and yellowness values of chicken nuggets were significant ($p < 0.05$). L^* value increased when carrot and sweet potato were added. These results indicate that addition of vegetable fibers from carrot and sweet potato resulted in lighter color products. The increase in L^* value could be due to the high content of white components. It was also found that treated samples showed highest redness (a^*) and yellowness (b^*) values; however, they differed nonsignificantly in between treated samples. Similar findings were also found in appearance and color scores during sensory analysis. Higher redness (a^*) and yellowness (b^*) values in products with carrot and sweet potato could be attributed to the presence of carotenoids in added vegetables. These findings are in agreement with the results obtained by Saleh and Ahmed (1998), who reported that incorporation of 10% boiled carrot and sweet potato increased lightness (L^*) and yellowness (b^*) values of ground beef patties. Intensity of redness (a^*) value was higher in carrot-added patties than sweet potato. Naveena et al. (2005) reported that incorporation of DF from ragi flour resulted in lower ($p < 0.05$) lightness (L^*) and yellowness (b^*) values compared to control samples.

Table 5. Effect of RC and MSP on color profiles of chicken nuggets.

Parameter	Control	RC (10%)	MSP (%)
Lightness (L^*)	50.34±1.41 a	55.60±0.51 b	55.44±0.10 b
Redness (a^*)	11.14±0.75 a	13.51±0.13 b	12.01±0.14 ab
Yellowness (b^*)	21.19±0.91 a	23.85±0.24 b	23.83±0.64 b

Values (mean ± SE, $n = 6$) followed by different letters within row-wise differ significantly ($p < 0.05$).

Texture Profile Analysis

Results of textural value indicated samples with RC and MSP had nonsignificant effect on hardness value (Table 6). Similar results had also been obtained by Garcia et al. (2002) in a study involving addition of fruit fibers. However, the textural value is accorded the results of sensory evaluation. The carrot-added nugget samples had highest values of springiness ($p > 0.05$), but they were comparable to those of control and MSP-added samples. This could be attributed due to the differences in level of interactions between carrot and sweet potato fibers as well as meat. With respect to cohesiveness, samples containing sweet potato had lower value as compared to control. The highest value for chewiness was found for carrot-formulated products. Resilience value however was higher for sweet potato-added samples. These findings suggested that addition of carrot and sweet potato had beneficial effects on the textural properties of chicken nuggets.

CONCLUSIONS

This study suggests that RC and boiled sweet potato had potential as good source of DF and biochemically active compounds such as β-carotene. Additions of carrot and sweet potato were also found to be effective in sustaining the desired cooking yield and emulsion stability with better color and textural values. Results on nutritional value indicated that β-carotene represents 1.1–1.2% of the recommended daily intake (30 000 μg per day, based on vitamin A). The representation for DF was 4.72% of the RDA (25 g per day). So, carrot and sweet potato have a great potential for improvement of nutritional value of developed products besides several health beneficial effects, and may also find their way in processed meat industry.

Table 6. Effect of RC and MWP on texture profiles of chicken nuggets.

Parameter	Control	RC (10%)	MSP (10%)
Hardness (N)	16.66±0.62	16.21±0.93	16.33±0.84
Springiness (cm)	0.84±0.09	0.87±0.07	0.82±0.04
Cohesiveness (ratio)	0.48±0.01 b	0.47±0.01 b	0.40±0.01 a
Chewiness (N cm)	6.91±0.60	7.01±0.70	6.28±0.47
Resilience (ratio)	0.23±0.02 a	0.26±0.01 ab	0.28±0.01 b

Values (mean ± SE, $n = 6$) followed by different letters within row-wise differ significantly ($p < 0.05$).

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