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Effect of frying oils and processing operations on colour, textural and sensorial properties of potato chips

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Abstract

The study was carried out the effect of frying oils and processing operations on colour, textural and sensorial properties of potato chips while the chips were prepared by the motorized vegetable slicer. After slicing, pretreatments were applied to the potato chips. Colour L*, a* and b* values (CIE LAB Scale) of the pre frying chips and post frying of the chips/slices of potato was determined by using Colour meter. The whiteness index was indicated best in mustard oil fried potato chips as compared to refined oil frying. Present study showed that the yellow colour of mustard oil affects the colour parameters (L*, a*, b* and whiteness index) of potato chips. From the observation of sensory panelist given in Table 3 for potato chips, Highest score of overall acceptability was awarded 7.95 for treatment 2 treated and fried in refined oil followed 7.85 score for mustard oil fried sample in same treatment at 180 °C frying temperature. It is clear that the potato chips treated with Blanching with 0.5% KMS +0.5% CA+1% NaCl were found best acceptability followed by fried in refined oil.

Keywords: Colour, frying, processing, operations, pretreatments, texture

Introduction

Potato is a nourishing and wholesome food produces highest dry matter, carbohydrates, edible protein, minerals and vitamins. It contains high quality protein which is superior against the cereal protein. The potato protein is rich in lysine, an essential amino acid. Potato is a perishable commodity and the 'king of vegetables' which contributes about 85 per cent of total production in India. Indian vegetable basket is incomplete without including Potato. It is an essential ingredient part of daily human diet in many ways. Slicing may help in the extraction of desirable constituents from raw materials easily due to its reduction in size like for making of chips (wafers). Slicing is a type of size reduction operation which makes the thin slices of fruits and vegetables with help of the sharp knife's edge or motorized slicers. Thickness of chips or slices can be obtained with definite gap between the sharp blades. The slicer cannot change the chemical constituents of the finished product. Because frying is a rapid heat transfer method that achieves a greater temperature than boiling or dry heat temperature, it is a common cooking technique. During drying at high temperature above boiling, the moisture replaced by the oil absorbed. The levels of oil absorption in frying process are influenced by frying time, food content, surface treatment, and other factors also. During frying the more oil is being absorbed in place of the moisture loss due to the higher concentration of starch content, less fat is absorbed during frying. Though, granule distribution irregularities remain an issue throughout the tuber. Frying is a unit operation which is mostly employed to change how a dish tastes when eaten. The preservation impact comes from the thermal death of microorganisms and enzymes, as well as a decrease in water activity at the product's surface (or throughout the food, if it's fried in thin slices), are secondary factors to take into account.

Frying is the process where food is placed in hot oil, the surface temperature rises rapidly and water is vaporised as steam expressed by Fellows [1]**.** The rates of heat and mass transport are governed by thickness of the vegetables chips. The process of "frying" is when frying oil partially replaces the internal water that evaporates from cells when they get dry. The product then absorbs the frying oil, replenishing the lost water. Potato slices are quickly dehydrated when placed in heated oil because moisture quickly evaporates in a spray of bubbles. A diffusion gradient is created by the dry outside surface, and a pressure gradient is created when the inside moisture turns to steam.

One of the most crucial physical criteria for choosing food is colour that affects consumer perception and may be the reason a certain product is rejected. An investigation of a food's mechanical, geometrical, fat, and moisture features, as well as their presence to what extent and in what order from the initial bite through full mastication, is called an organoleptic analysis of the texture complex. A double-bite test called the TPA provides more in-depth information, such as gumminess, springiness, chewiness, and adhesiveness. The use of sensory assessment methodologies allows for the precise measurement of consumer reactions to food while minimizing the potential for brand identification and other factors to skew consumer perception. As a result, it makes an effort to separate the sensory characteristics of food from other factors and offers significant and practical information to managers, food scientists, and product developers on the sensory qualities of their products. A measuring science is sensory evaluation. Sensory evaluation is concerned with precision, accuracy, sensitivity, and avoiding false positives, just like other analytical test processes.

Materials and Methods

The present investigation was carried out to study effect of frying oils and processing operations on colour, textural and sensorial properties of potato chips. The chips of potato were prepared by the motorized vegetable slicer. The work was conducted during 2022 in the laboratory developed under the RKVY project on "Agro Processing Centre" in the College of Post Harvest Technology and Food Processing, S.V.P. University of Agriculture & Technology, Meerut. Studies were also carried out to evaluate colour, textural and sensorial properties of potato chips in different employing processing operations as well as pre-treatments. Fresh vegetables were procured from the local market Meerut. Leaves and end portion were removed with a sharp-edged knife, washed with tap water to remove the dust and dirt over the surface. Peeled and again washed with water followed by slicing with a motorized slicer. The chips were then weighed and achieved sliced weight samples were made for each pre-treatment and drying and frying achieved as per experimental plan. The sliced was subjected to pre-treatments indicated as (T_1) Blanching with 0.5% KMS + 0.5% CA, (T_2) Blanching with 0.5% KMS + 0.5% CA +1% NaCl and (T_3) Blanching with 0.5% KMS + 1.0% NaCl. The slices were then removed from the solution and the surface moisture was removed by blotting paper then after slices were spread in trays subjected to drying in tray dryer at 65 °C, after drying potato chips fried in mustard and refined oil.

Colour measurement

A filter colourimeter called a colour meter divides the elements of reflected colour into a three-dimensional colour scale. With L* measuring light to dark colour components, a* being a red-green scale, and b* being a yellow-blue scale. The L*, a*, and b* colour scales viewed colour similarly to how the human eye does. Colour of the raw and fried chips was measured using a colourimeter (3nH Colour meter, China) after calibration with a white reference plate. The lightness (L*), redness (a*), and yellowness (b*) values of slices were measured. The whiteness index was measured by the whiteness meter**.**

Texture Analysis

The texture (TA and TPA) was analysed by texture analyser was carried out by TA.HD Plus C texture analyser (M/s. Stable Microsystems, Surrey, UK). The samples were compressed at a speed of 0.5 mm/s to a distance of 10.0 mm using knife edge with slotted inserted (HDP/BS). A force-time curve was produced by twice compressing a material, from which the properties of hardness (first peak height), adhesiveness (negative area of the curve during probe retraction), cohesiveness (ratio between second peak and first peak area), and gumminess (product of hardness and cohesiveness) could be determined. Averaging out three separate measurements was done.

The parameters used for the test were: 50 kg force load cell, pre-test, test and post-test speeds equal to 2.0 mm/s, 2.0 mm/c and 10 mm/s respectively; distance 5 mm and trigger force for Potato was 7g for the slice thickness varied 0.25-0.45 mm. The textural properties like hardness, resilience, springiness, cohesiveness and chewiness were calculated as described by Correia *et al*., [2].

Sensory Evaluation

Sensory evaluation is important to evaluate the consumer's acceptance. Food samples should have a typical colour, taste, flavour and texture etc. It was carried out for taste, colour, texture and overall acceptability. A sample of food product was served for the evaluation by 10 panellists at a time. Judgments were made through rating products on a 9-point Hedonic scale with corresponding descriptive terms ranging from 9 (like extremely) to 1 (dislike extremely). Sample with highest rating was chosen as given by Kelapure and Nirve [3].

Results and Discussion

Colour quest and whiteness of potato chips

Colour parameters L*, a* and b* values (CIE LAB Scale) of the pre frying chips and post frying of the chips of potato was determined by 3nh Colour meter (China). The effect of processing operations and frying oils on the colour of potato chips is given in following sections.

Treatment 1: The potato fresh chips were treated with three types of treatments *viz*., (i) blanching with 0.5% KMS + 0.5% CA, (ii) blanching with 0.5% KMS +0.5% CA+1% NaCl; and (iii) blanching with 0.5% KMS + 1% NaCl showed in Table 1. From the Table 1, the score of L*, a* and b* values of fresh cut potato chips were 51.95, -0.75 and 5.32; post-blanching scores were 52.95, -2.90 and -5.66 and after cooling it was scored 55.43, -2.94 and -5.17 respectively. The results indicated that the value of L* is increased with treatment of blanching and cooling. Blanching and cooling affect the lightness and value of a*of potato chips. The lightness and whiteness index of the potato chips increased by the treatment of blanching followed by cooling. The lightness and whiteness of potato chips was increased due to inactivation of enzyme by the blanching in hot water at 95 °C for 3-5 min. The value of a* and b* decreased with the blanching in KMS (0.5%) & CA (0.5%) and cooling treatment. It may be due to the destruction of natural colour pigments of potato chips during the blanching treatment at higher temperature. The value of the whiteness index was observed for fresh (44.60), blanching (47.17) and cooling (50.17). The study revealed that slight increment in whiteness index was observed that the discolouration impact of enzymes was destroyed during blanching process and some colour pigments may also be leached out in cooling water after blanching.

Table 1: Effect of processing operations, frying oil and frying temperature on colour quest and whiteness index of potato chips

Treatment (T_1): Blanching with 0.5% KMS + 0.5% CA						
Processing			L*	a*	b*	W.I.
Fresh			51.95	-0.75	5.32	44.60
Blanching			52.54	-2.90	-5.66	47.17
Cooling			55.43	-2.94	-5.17	50.17
Frying	Mustard oil	170 °C	55.18	-1.00	22.77	25.57
		175 °C	64.36	-2.45	24.55	31.26
		180 °C	55.43	-2.94	-5.17	50.17
	Refined oil	170 °C	60.41	-1.48	20.53	34.13
		175 °C	67.79	-2.27	26.08	35.47
		180 °C	54.76	-3.06	21.59	24.50
Treatment 2: Blanching with 0.5% KMS +0.5% CA+1% NaCl)						
Fresh			76.01	-2.00	12.76	34.67
Blanching			76.36	-1.85	6.92	37.17
Cooling			75.76	-2.39	-9.78	40.27
Frying	Mustard oil	170 °C	51.66	-2.15	25.07	19.50
		175 °C	59.45	-0.93	25.55	20.23
		180 °C	52.83	-2.43	26.05	20.67
	Refined oil	170 °C	59.83	2.58	30.08	34.06
		175 °C	71.29	-0.42	29.53	33.13
		180 °C	65.71	4.68	28.74	31.67
Treatment 3: Blanching with 0.5% KMS + 1% NaCl)						
Fresh			71.70	0.66	2.51	61.60
Blanching			59.31	-1.06	-1.07	57.87
Cooling			53.47	0.97	-2.58	53.70
Frying oils and temperature	Mustard oil	170 °C	54.76	-3.06	14.75	29.50
		175 °C	55.18	-1.00	13.63	31.57
		180 °C	64.36	-2.45	10.52	32.93
	Refined oil	170 °C	34.36	15.25	30.25	10.03
		175 °C	32.95	12.25	26.10	12.03
		180 °C	29.37	11.24	23.80	12.23
(KMS: Potassium metabisulphite, CA: Citric acid)						

Treatment 2: The L*, a* and b* score for treatment 2 (Blanching with 0.5% KMS +0.5% CA+1% NaCl) for raw potato chips were observed 76.01, -2.00 and 12.76, while after blanching 76.36, -1.85 and 6.92, and cooling was 75.76, -2.39 and -9.78. The score of whiteness index was observed for fresh chips 34.67, after blanching treatment 37.17 and cooling 40.27. The study revealed that the sodium chloride affects the invariable effect on the L*, a*, b* while increased the whiteness index of the potato chips treated with blanching in KMS (0.5%) + CA (0.5%) + NaCl (1%). The raw potato used for this treatment is other than treatment 1. The value of the colour quest for this potato chip than above treatment. Negative value of a* indicated that the greenish colour of the potato chips in initial stage to the cooling treatment. It means that potato contains the traces of solanine in raw potatoes which did not destroy in blanching treatment, and lastly affect the value of a*. The effect of treatments on lightness (L) of the chips was found slightly as observed data given in Table 4.4. The value of b* in fresh was observed 12.76, after blanching 6.92 and cooling -9.78. The results of b* showed that the value of b* decreased with treatments from yellowness (+ b* values) to blueness (-b values). The value of the b* was decreased due to maillard reaction takes place at high temperature of blanching.

The effect of frying oils and frying temperatures were observed on the potato chips treated with blanching in KMS (0.5%) + CA (0.5%) + NaCl (1%). The frying oil *viz*., mustard oil and refined oil used to fry the treated potato chips at 170, 175 and 180 °C frying temperature. The best results on colour (L*) was found in refined oil fried potato chips at the temperature of 175 °C i.e., 71.29 near to the lightness as compared to other fried chips in different oils and different temperatures. The whiteness index was indicated best in refined oil fried potato chips as compared to mustard oil frying. Present study of the treatment 2 potato chips showed that the yellow colour of mustard oil affects the colour attributes like L*, a*, b* and whiteness index of potato chips. The score of b* was observed higher in refined oil (28.74-30.08) while in mustard oil (25.07-26.05). It is revealed that the mustard oil imparts good score as compared refined oil. Study is also indicated that the addition of NaCl gives good results with refined oil fried potato chips. Colour changes in the fried chips may be due to Maillard reaction during frying of higher temperatures. Waumba *et al*., [4] reported the higher amount of reducing sugars induces browning discolouration in the potato chips during frying. Abong *et al*., [5] discussed the colour of the potato chips may be influenced by the maillard reaction which depends on the amount of reducing sugars and amino acids at the potato tubers as well as frying time and temperatures combination.

The potato fresh chips were treated with three types of treatments *viz*., (i) blanching with 0.5% KMS + 0.5% CA, (ii) blanching with 0.5% KMS +0.5% CA+1% NaCl; and (iii) blanching with 0.5% KMS + 1% NaCl showed in Table 4.4. From the table 4.4, the L*, a* and b* values of fresh potato chips were 51.95, -0.75 and 5.32; post-blanching score were 52.95, -2.90 and -5.66 and after cooling it was scored 55.43, -2.94 and -5.17 respectively. The results indicated that the value of L* is increased with treatment of blanching and cooling. Blanching and cooling affect the lightness and value of a*of potato chips. The lightness and whiteness index of the potato chips increased by the treatment of blanching followed by cooling. The lightness and whiteness of potato chips was increased due to inactivation of enzyme by the blanching treatment in hot water at 95 °C for 3-5 min. The value of a* and b* decreased with the blanching in KMS (0.5%) & CA (0.5%) and cooling treatment. It may be due to the destruction of natural colour pigments of potato chips during the blanching treatment at higher temperature. The value of the whiteness index was observed for fresh (44.60), blanching (47.17) and cooling (50.17). The study revealed that slight increment in whiteness index was observed that the discolouration impact of enzymes was destroyed during blanching process and some colour pigments may also be leached out in cooling water after blanching.

Treatment 3: The L*, a* and b* score for treatment 3 (Blanching with 0.5% KMS +1% NaCl) for raw potato chips were observed 71.70, 0.66 and 2.51, while after blanching 59.31, -1.06 and -1.07, and cooling was 53.47, 0.97 and -2.58. The score of whiteness index was observed for fresh chips 61.60, after blanching treatment 57.87 and cooling 53.7. The study revealed that the sodium chloride affects the invariable effect on the L*, a*, b* while increased the whiteness index of the potato chips treated with blanching in KMS (0.5%) + NaCl (1%). The raw potato used for this treatment is other than treatment 1. The value of the colour quest for this potato chip than above treatment. Negative value of a* indicated that the greenish colour of the potato chips in initial stage to the cooling treatment. It means that potato contains the traces of solanine in raw potatoes which did not destroy in blanching treatment, and lastly affect the value of a*. The effect of treatments on lightness (L) of the chips was found slightly as observed data given in Table 4.4. The value of b* in fresh was observed 2.51, after blanching -1.07 and cooling -2.58. The results of b* showed that the value of b* decreased with treatments from yellowness (+ b* values) to blueness (-b values). The value of the b* decreased due to maillard reaction at blanching temperature.

The effect of frying oil and frying temperature was observed on the potato chips treated with blanching in KMS (0.5%) + NaCl (1%). The frying oil *viz*., mustard oil and refined oil used to fry the treated potato chips at 170, 175 and 180 °C frying temperature. The best results on colour (L*) was found in mustard oil fried potato chips at the temperature of 180 °C i.e., 64.36 near to the lightness as compared to other fried chips in different oils and different temperatures. The whiteness index was indicated best in mustard oil fried potato chips as compared to refined oil frying. Present study of the treatment 3 potato chips showed that the yellow colour of mustard oil affects the colour parameters (L*, a*, b* and whiteness index) of potato chips. The score of b* was observed higher in refined oil (23.80-30.25) while in mustard oil (10.52-14.75). It is revealed that the mustard oil imparts good score as compared refined oil. Study is also indicated that the addition of NaCl gives good results with mustard oil fried potato chips. Colour changes in the fried chips may be due to Maillard reaction during frying of higher temperatures.

Texture Profile Analysis of potato chips

Texture is one of the most important attributes for evaluating the quality of foodstuffs. In the case of potato chips, consumers' satisfaction strongly depends on the chips' texture expressed by Waumba *et al*., [4]. The textural properties of potato chips were estimated by using a Texture Analyzer (TA-XT$_2$i, Stable Micro Systems, Godalming, UK).

The chips samples used to evaluate hardness, adhesiveness, resilience, cohesion, springiness, gumminess and chewiness. Hardness (as the fracture force) of chips was set at a trigger force of 25 g using a load cell of 50 kg, and was the maximum value of the force (g) at the chips' breaking point. Tests were done in triplicate.

Table 2: Effect of pre-treatments and frying temperature and oil (mustard oil) on texture profile analysis (TPA) of potato chips

Frying Temp	Hardness g	Adhesiveness J	Resilience %	Cohesion %	Springiness %	Gumminess g	Chewiness J
Mustard oil							
170 °C	986.236	668.464	7.476	0.948	81.470	975.645	815.981
175 °C	969.498	1006.957	8.117	0.999	80.952	968.737	784.216
180 °C	863.404	731.784	8.580	1.000	71.429	863.392	616.709
Refined oil							
170 °C	766.672	968.464	13.476	0.925	41.270	765.645	315.981
175 °C	663.573	775.452	9.775	1.001	42.857	691.375	253.447
180 °C	595.838	690.157	8.748	1.125	45.885	605.250	252.250

The hardness (986.236-863.404g), springiness (81.470-71.429%), gumminess (975.645-863.392g) and chewiness (815.981-616.709J) of potato chips decreased whereas resilience (7.476-8.580%), cohesiveness (0.948-1.000%) and adhesiveness (668.464-731.784J) increased in mustard oil fried potato chips with increasing frying temperatures from 170 to 180 °C (Table 2). The From Table 2, the study indicated that the hardness (766.672-595.838), adhesiveness (968.454-690.157), resilience (13.476-8.748), gumminess (765.645-605.250) and chewiness (315.981-252.250) were decreased whereas cohesiveness (0.925-1.125) and springiness (41.270-45.885) increased in refined oil fried with increasing frying temperatures from 170 to 180 °C. The higher value of hardness was found in mustard frying potato chips as compared to refined oil. It is clear that the refined oil used for frying of potato chips obtained less hardness as compared to mustard oil varying frying temperature. Hardness of potato chips depend on the oil absorption by the chips during frying. Low temperature of frying was indicated more hardness than the increasing frying temperature (170 to 180 °C) showed in Table 2. Texture is also controlled by starch content of potatoes reported by Van Marle *et al*., [5]. It gives firmness to texture of processed products of potatoes. Poor texture of French fries and fried chips may also be affected by sugar content of potatoes as reported by Adams [6] that potatoes having high sugar content showed poor/soft texture after cooking. But the texture of fries was also influenced by reducing sugar content and dry matter of tubers [7-8]. Mehdi *et al*., [9] suggested more dry matter contents for French fries. Potatoes having high dry matter showed mealiness when processed.

Sensory quality of Potato chips

The sensorial acceptability of the potato chips on a 9-point hedonic scale is given in Table 3. The ingredient which was used frying, is responsible for mouth feel, taste, colour, flavour and overall product appearance. Any product must give pleasure and satisfaction to the consumers if it has to be a part of their eating behaviour expressed by Khan *et al*., [10]. Each panelist evaluated 3-sample of chips in one session. Colour and crispness are one of the most important physical parameters to select the chips that influences consumer perception and can be the reason of the rejection of the product reported by Khan *et al*., [10]. The possible reason may be replacement of some panel members by new also may be because of inconsistency in the judgement of panel members. Therefore, these variations were observed.

Table 3: Effect of treatments, frying oils, frying temperatures on the sensory quality of potato chips

Treatments	Mustard oil			Refined oil		
Colour						
	170 °C	175 °C	180 °C	170 °C	175 °C	180 °C
T_1	7.28	7.35	7.55	7.38	7.45	7.55
T_2	7.30	7.45	7.50	7.33	7.48	7.55
T_3	7.20	7.32	7.35	7.30	7.35	7.50
Texture						
T_1	7.15	7.28	7.55	7.25	7.30	7.50
T_2	7.18	7.35	7.66	7.40	7.50	7.70
T_3	7.65	7.25	7.28	7.72	7.75	7.80
Taste						
T_1	7.05	7.25	7.50	7.20	7.25	7.30
T_2	7.12	7.20	7.80	7.60	7.65	7.90
T_3	7.35	7.40	7.45	7.45	7.50	7.65
Crispiness						
T_1	7.50	7.15	7.65	7.55	7.25	7.35
T_2	7.00	7.16	7.40	7.50	7.56	7.60
T_3	7.28	7.30	7.35	7.40	7.45	7.55
Overall acceptability						
T_1	7.05	7.20	7.50	7.15	7.25	7.55
T_2	7.60	7.75	7.85	7.65	7.85	7.95
T_3	7.65	7.68	7.75	7.75	7.80	7.65

The sensory data for colour scores of fresh potato chips fried in mustard and refined oil just after preparation are presented in Table 3. The highest colour score was awarded for refined oil fried chips and lowest for mustard oil fried chips. As per cumulative score of colours in potato chips, refined oil gives the better colour than the mustard oil among the varying frying temperature and treatments. The observation on colour from the table 3 showed that chips fried at 180 °C temperature had higher score against the 170 and 175 °C frying temperature. The study reported that colour scores were increased with increasing frying temperatures. Sensorial study also revealed that chips for potato friend in different frying oil at different temperature were rated between like moderately to like very much among all the samples. The colour score increased or decreased unexpectedly for some samples. The possible reason may be replacement of some panel members by new also may be because of inconsistency in the judgment of panel members. Since, these variations were observed little. This changes in colour score may be attributed to darker colour due to browning effect during frying.

The texture scores of fresh potato chips fried in mustard and refined oil just after preparation are presented in Table 3. The texture score for mustard oil frying varied 7.15-7.66 among all frying temperature and treatments while in refined oil was 7.25-7.80. The highest colour score of texture was reported for refined oil fried chips and lowest for mustard oil fried chips. As per cumulative score of colours, refined oil gives the better texture than the mustard colour in potato chips among the varying frying temperature and treatments. The observation on texture for potato chips from the table 3 showed that the chips fried at 180 °C temperature had higher score against the 170 and 175 °C frying temperature. The study depicted that texture scores was increased with increasing frying temperature. Sensorial study also revealed that chips for potato friend in different frying oil at different temperature were rated between like moderately to like very much among all the samples. The texture score increased or decreased unexpectedly for some samples. The possible reason may be replacement of some panel members by new also may be because of inconsistency in the judgment of panel members. Since, these variations were observed little. This changes in texture score may be attributed due low temperature of frying less than 180 °C.

The variation in taste scores for potato chips is presented in Table 3. The results revealed that refined oil fried chips observed highest taste score while lowest in mustard oil fried toward between 'like very much' to 'like extremely' among all the samples. Taste score of potato chips were decreased with increasing frying temperatures from 170 to 180 °C. Frying oils were also affected the sensory score for taste during frying. Refined oil was found better than mustard oil for frying of potato chips. Among the frying temperature, treatments and frying oils, the treatment 2 (Blanching with 0.5% KMS +0.5% CA+1% NaCl) samples had highest score of taste (7.90) fried in refined oil at 180 °C and followed by same treatment in mustard oil (7.90). The study revealed that both oils had very low different in taste score, if fried at 180 °C temperature. Lowest score of taste was observed 7.05 for treatment 1 (Blanching with 0.5% KMS + 0.5% CA) fried in mustard oil at 170 °C.

Crispiness is perceived when food is chewed between molars, and is usually expressed in terms of hardness and factorability by Noor Aziah and Komathi [11]. The sensory score for variation in crispiness of potato chips are given in Table 3. Results of the study revealed that mustard oil fried chips observed highest crispiness score while lowest in refined oil fried toward between 'like very much' to 'like extremely' among all the samples. Crispiness score increased with increasing frying temperature from 170 to

180 °C. Frying oils were also affected the sensory score for crispiness during frying. Mustard oil was found better than refined oil for frying of potato chips. Among the frying temperature, treatments and frying oils, the treatment 1 (Blanching with 0.5% KMS + 0.5% CA) samples had highest score of crispiness (7.65) fried in both mustard at 180 °C and followed by Treatment 2 in refined oil (7.60). The study revealed that both oils had very low different in crispiness score, if fried at 180 °C temperature. Lowest score of crispiness was observed 7.25 for treatment 2 (Blanching with 0.5% KMS +0.5% CA+1% NaCl) fried in mustard oil at 170 °C. The crispiness is a complex attributed resulting on the one hand from multiple sensations and on the other from multiple physical parameters, combining molecular, structural and manufacturing processes, as well as storage conditions given by Roudaut *et al*., [12].

The data of overall acceptability of fresh potato chips fried in mustard and refined oil just after preparation are presented in Table 3. The overall acceptability score for mustard oil frying varied 7.05-7.85 among all frying temperature and treatments while in refined oil was 7.15-7.95. The highest score of overall acceptability was awarded for refined oil fried chips and lowest for mustard oil fried chips. As per cumulative score of overall acceptability, refined oil gives the better overall acceptability than the mustard colour in potato chips among the varying frying temperature and treatments. The observation on overall acceptability for potato chips from the table 3 showed that the chips fried at 180 °C temperature had higher score against the 170 and 175 °C frying temperature. The study revealed that overall acceptability scores was increased with increasing frying temperature. Sensorial study also revealed that chips for potato friend in different frying oil at different temperature were rated between like moderately to like very much among all the samples. The overall acceptability score increased or decreased unexpectedly for some samples. The possible reason may be replacement of some panel members by new also may be because of inconsistency in the judgment of panel members. Since, these variations were observed little. This changes in overall acceptability score may be attributed due low temperature of frying less than 180 °C.

From the observation of sensory panelist given in Table 3 for potato chips, Highest score was awarded 7.95 for treatment 2 treated chip and fried in refined oil followed 7.85 score for mustard oil fried sample in same treatment. It is clear that the potato chip treated with Blanching with 0.5% KMS +0.5% CA+1% NaCl and followed by fried refined oil gives best consumer acceptability in fresh condition. Study is also indicated that mustard oil may be used as frying medium for potato chips with varying treatments and frying temperatures.

Conclusion

The effect of frying oil and frying temperature on the potato chips (T_2) was observed best score of L*a*b* treated with blanching in KMS (0.5%) +CA (0.5%) NaCl (1%) as compared to others at 175 °C. The best results on colour (L*) was found in refined oil fried potato chips at the temperature of 175 °C i.e., 71.29 near to the lightness as compared to other fried chips in different oils and different temperatures with whiteness index (33.13). The whiteness index was indicated best in mustard oil fried potato chips as compared to refined oil frying. Present study showed that the yellow colour of mustard oil affects the colour parameters (L*, a*, b* and whiteness index) of potato chips. From the observation of sensory panelist given in Table 3 for potato chips, Highest score of overall acceptability was awarded 7.95 for treatment 2 treated and fried in refined oil followed 7.85 score for mustard oil fried sample in same treatment at 180 °C frying temperature. It is clear that the potato chips treated with Blanching with 0.5% KMS +0.5% CA+1% NaCl and followed by fried in refined oil gives best consumer acceptability in fresh condition. Study is also indicated that mustard oil was subjected good score similar to refined oil used as frying medium for potato chips with varying treatments and frying temperatures.

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Conflict of Interest

We, the authors of the article “Effect of frying oils and processing operations on colour and textural properties of potato chips” wish to state that there are no conflicts of interests in this our research articles.

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