J. Farm Sci., 34(4): (460-462) 2021

RESEARCH NOTE

Effect of Pre-frying coating of potato slices with pectin and guar gum on quality and quantity of potato chips

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(Received: November, 2021 ; Accepted: December, 2021)

Abstract: The aim of study was to examine the effect of hydrocolloids as coating material on oil uptake and other properties of potato chips. The present investigation was conducted using pectin and guar gum as coating agents. Peeled potatoes (Potato *var.* Kufri Chipsona and Kufri Jyoti) were cut into 0.3 mm thick slices and blanched before coating with aqueous hydrocolloid solution. The coated slices were dried, before frying at 180^{0}C for 3 minutes. The fried slices were used for further study. The results, showed percent quantity of chips prepared from potato *var.* Kufri Chipsona is higher than Potato *var.* Kufri Jyoti. Percent quantity of chips from coated slices was more than non-coated slices. The fat content in chips prepared from potato *var*. Kufri Jyoti is lesser than potato *var*. Kufri Chipsona and fat content in chips prepared from coated slices is lesser than non-coated slices. Oil uptake of potato chips prepared from slices coated with guar gum is lesser than pectin in both varieties. Hardness in chips prepared from potato *var*. Kufri Chipsona is higher and coated chips are less harder. Between two potato varieties studied Kufri Jyoti is good for producing chips. Among two polysaccharides studied, it can be concluded that potato slices coated with guar gum absorbed lesser oil.

Key words: Fat content, Guar gum, Pectin, Potato chips

Potato chips, is a type of snacks made of potatoes (*Solanum tuberosum*) by deep fat frying thin potato slices and spiced according to the consumer preference. These are considered as high fat products, as they are reported to contain 35 - 43 g fat per 100 g of chips (Mioara Negoita *et al*., 2020). As per the recommendations of WHO and FAO daily intake of fat shall not exceed 30 % of total intake (https://www.who.int/news-room/fact-sheets). Therefore, among many quality parameters considered in fried chips, the amount of fat absorbed during frying is most important.

Reduction in fat absorption of potato slices in production of chips is of concern. Moreria and Barrufet (1999) reported some techniques to prevent excess oil uptake in chips by reducing moisture content of slices before frying using hot air or microwave radiation, blanching the slices before frying, and/or baking slices till crispy instead of frying. Since deep fat fried chips are more palatable, edible coatings are being considered as one of the promising techniques in reducing fat absorption. Film on slices acts as hurdle for migration of oil and water molecules, therefore it reduces water loss and lowers excessive oil absorption during frying. Also, coatings form brittle and tougher surface with less voids during frying and have no negative influence on sensory attributes (Mia Kurek *et al*., 2017).

Hydrocolloids coatings are chosen for study due to their thermo-gelling properties and as they are invisible. For the purpose of this study, pectin and guar gum are selected considering abundant availability and their lower cost. Pectin is a family of heterogeneous branched polysaccharides composed of b-1, 4-linked D-galacturonic acid residues, wherein the uronic acid carboxyls are either fully (high methoxy pectin) or partially (low methoxy pectin) methyl esterified. Guar gum, a galactomannan obtained from the Indian cluster bean (*Cyamopsis tetragonoloba* (L.) Taub), is a water soluble polysaccharide. These edible coatings are more studied for increasing the keeping quality of fresh cut fruits and vegetables (Fakhreddin Salehi**,** 2020); however, in the case of reducing the oil uptake, only few investigations have been reported. Keeping this in view, the study was conducted under laboratory conditions to understand the influence of pectin and guar gum coatings on chips yield, moisture content, fat, and hardness of chips.

The experiment was conducted in Department of Food Engineering, B.Tech. (Food Technology), College of Community Science, University of Agricultural Sciences, Dharwad during 2017-18 under laboratory conditions.. Potato varieties *viz*., Kufri Chipsona and Kufri Jyoti, Sunflower oil, pectin and guar gum were procured from Dharwad local market. There were six treatments *viz*., T_1 : Kufri Chipsona Without coating, T_2 : Kufri Chipsona Coated with 1% Pectin, T_3 : Kufri Chipsona Coated with 1% guar gum, T_4 : Kufri Jyothi Without coating, T_5 : Kufri Jyothi Coated with 1% Pectin, T_6 : Kufri Jyothi Coated with 1% guar gum replicated thrice.

One gram of pectin was dissolved in 20 ml of water before adding to boiling water, then the mixture was heated for five minutes and filtered to obtain the aqueous pectin solution. The aqueous pectin solution's volume was made to 100 ml by adding warm water and mixed well before coating. Similar procedure was adopted for the preparation of aqueous solution of guar gum.

Potatoes were washed, peeled, trimmed and sliced in to 0.3 mm thick slices. Potato slices were blanched in 1 % potassium meta-bisulphite solution for 1 min and dewatered. Dewatered slices were coated with prepared aqueous solution of pectin and gura gum as per the treatments using 0.5 mm brush and shade dried for 30 minutes. These dried slices were fried at 180^{0}C for 3 minutes. Chips without coating fried after dewatering at 180^{0}C for 3 minutes were used as control for comparison of the coated treatments. Potato chips were packed in metallized films with nitrogen flushing for further study.

Chips were analysed for moisture using AOAC 930.15 method, fat using AOAC method 920.39C, and hardness using TAXT plus Texture Analyzer (Stable Microsystems) in Department of Food Science and Nutrition. For measuring Hardness compression was carried out with load cell of 100 N, the test was replicated with minimum 5 chips. Yield of potato chips was calculated by considering weight of potato. Mean values of triplicates were compared with Duncan Multiple Range Test using OPSTAT developed by O.P.Sheoran., C.C.S. HAU, Hisar. The recorded observations were analysed by two way factor ANOVA, F-Test Two Sample of variances and regression using Microsoft Excel. Interpretation of results was done based on the guidelines suggested by Kothari and Gaurav (2019).

The data on fried chips quantity and quality parameters is presented in Table 1. It was found that per cent quantity of chips prepared from Potato *var*. Kufri Chipsona (28.50 %) is higher than chips prepared from potato *var*. Kufri Jyoti (26.5 %) which may be due to inherent characteristics of variety of potato used. It is also evident from Table 1 that quantity of chips (%) prepared from coated potato slices (31 % in Kufri Chiposona and 28 % in Kufri Jyothi) was more than the quantity of chips prepared from non-coated slices (28.5 % in Kufri Chiposona and 26 % in Kufri Jyothi). It may be to coating, as coating reduces the water loss from the slices. Albert and Mittal (2002) also recorded that chitosan coating lowers the water loss and yield will be higher.

Moisture content data of chips from the table 1, indicates higher moisture per cent from chips prepared using non-coated slices of Potato *var*. Kufri Jyoti (5.62 %) compared chips prepared from non-coated slices of Potato *var*. Kufri Chipsona (4.68 %). It was may be due its inherent moisture. Readings also shows that moisture per cent in chips prepared from coated slices is lesser (15-19 % lesser in Kufri Chipsona and 51-53 % lesser in Kufri Jyoti) than chips prepared from non-coated slices, it may be possibly due to binding of water by hydrocolloids. As binding of water molecules by hydrocolloids, decreases the diffusion of water molecules from the surface of the chips. Funami *et al*., (1999) endorsed that during frying hydrocolloid coatings form more brittle and stronger surface with fewer voids that prevents water and steam escape from the porous surface thereby adequate moisture within the sample is maintained. Freitas *et al*., (2009) also reported that higher moisture retention in pectin coated on cassava roots during frying.

Data of fat content in chips represented in table 1 indicates that the fat per cent of chips prepared from slices coated with pectin (26.33 % decrease in Kufri Chipsona and 28.93 % decrease in Kufri Jyothi) and guar gum (43.01 % decrease in Kufri Chipsona and 38.06 % decrease in Kufri Jyothi) is lesser than chips prepared from non-coated potato slices. Coating on slices increases water holding capacity by entrapping moisture inside slices and prevents moisture replacement leading to lesser uptake of oil during frying. In non-coated slices, water evaporates through pores in the crust replacing oil and leads to oil concentrated crust.

Kim *et al*., (2011) found that lower uptake of oil was due to reduced heat transfer coefficients because of coatings. Sothornvit (2011) as well found combination of guar gum coating as pre-treatment and the de-oiling after frying in centrifuge (280 rpm) reduces oil absorption in vacuum fried banana chips (33.7%). Daraei Garmakhany *et al*., (2014) and Hua *et al*., (2015) reported that French fries and chips prepared from pectin coated potatoes slices lead to lesser oil uptake. Izadi *et al*., (2015) also observed that gum coatings acts as barrier for uptake of oil by reducing the number of pores and cracks formation in fried products. Hardness data of chips in Table 1 shows higher values for chips prepared from non coated slices of Potato *var*. Kufri Chipsona (2052 N) compared to chips prepared from non coated slices of Potato *var*. Kufri Jyothi (857 N). As chips prepared from slices of Potato *var*. Kufri Jyoti contain higher moisture content (5.62 %), crunchiness is lesser. It is also evident from the data in table 1 that hardness of chips prepared from coated slices is higher than chips prepared from non coated slices. This may be due to higher moisture content of chips prepared from the coated slices than the chips prepared from non-coated slices, as higher moisture content reduces the crunchiness. Mirzaei *et al*., (2015) endorsed hardness in methyl cellulose coated samples is due to interaction between coating material and cell wall.

Data of regression in Table 2, shows that relation between moisture content and hardness is non-significant ($p \leq 0.05$). The value of R and R square indicates that the relationship is not exactly fitting into linear regression model. This indicates that other factors than the moisture content of chips is also influencing the hardness of chips. The other factors may be interaction of cell and coating material, inherent characteristics of potato that may differ with frying. Data in Table 3, proves that there is significance differences in hardness of chips as

Table 1. Effect of prefrying coatings of pectin and guar gum to potato slices on quantity and quality parameters of potato chips

Treatment	% qty of chips obtained	Change in qty over control (%)	Moisture (%)	Decrease in Moisture over control (%)	Fat (%)	Decrease in Fat over control (%)	Hardness (N)	Decrease in Hardness over control (%)
T_1	28.50^a	-	4.68^a	-	46.03^a	-	2052.00^a	-
T_2	31.00^a	8.77	3.78^a	-19.23	33.91^{ab}	-26.33	664.00^d	-67.64
T_3	31.00^a	8.77	3.94^a	-15.81	26.23^{ab}	-43.01	1342.00^b	-34.6
T_4	26.50^a	-	5.62^a	-	26.40^{ab}	-	857.00^c	-
T_5	25.00^a	-5.66	2.74^a	-51.24	18.76^b	-28.93	693.00^d	-19.13
T_6	28.00^a	5.66	2.60^a	-53.73	16.35^b	-38.06	482.00^e	-43.95
S.Em.±	0.98		0.47		4.42		239.32	
p (0.05)	NS		NS		0.002*		0.0052*	

Note : * Significant (p d" 0.05), NS – Non-significant qty: quantity

T_1 : Kufri Chipsona Without coating (Control) T_2 : Kufri Chipsona Coated with 1% Pectin T_3 : Kufri Chipsona Coated with 1% guar gum
T_4 : Kufri Jyothi Without coating (Control) T_5 : Kufri Jyothi Coated with 1% Pectin T_6 : Kufri Jyothi Coated with 1% guar gum

Table 2. Interaction of moisture content with quantity and hardness in potato chips

Parameters	Regression between	
	Moisture content and quantity	Moisture content and Hardness
Multiple R	0.076	0.492
R Square	0.005	0.242
P-value	0.002	0.967
Significance F	0.884	0.321

Table 3. Effect of coating on hardness of chips using F-Test Two Sample of variances

Parameters	Samples	F	F Critical one-tail	Significance
Hardness	C (T_1 & T_4) with P (T_2 & T_5)	1698.008	161.447	Significant
	C (T_1 & T_4) with G (T_3 & T_6)	1.931	161.447	NS
	P (T_2 & T_5) with G (T_3 & T_6)	0.001	0.006	NS

T_1 : Kufri Chipsona Without coating
T_2 : Kufri Chipsona Coated with 1% Pectin
T_3 : Kufri Chipsona Coated with 1% guar gum
T_4 : Kufri Jyothi Without coating
T_5 : Kufri Jyothi Coated with 1% Pectin
T_6 : Kufri Jyothi Coated with 1% guar gum

Note : * F > F Critical one-tail : Significant; F < F Critical one-tail : NS (Non-Significant)

coating applied differs. It indicates that slices treated before frying with pectin coating is significantly different from that of guar gum. The difference may be attributed to properties of pectin and guar gum. It is evident from the table 3, that guar gum coatings do not significantly affect the hardness of chips. Thus guar gum coating can be used to reduce fat content without affecting the hardness of chips.

Chips prepared from both Potato varieties *viz*., Kufri Jyoti and Kufri Chipsona by coated slices with aqueous solution of guar gum and pectin absorbed lesser oil than chips prepared from non-coated slices. Among two polysaccharides studied at one per cent for pre-frying treatment of Potato chips of both the varieties, the slices coated with 1% guar gum was found better considering fat content, yield and hardness of chips., further the crispiness, yield and fat content of Potato chips prepared from Kufri Jyoti were more acceptable as compared to chips prepared from Kufri Chipsona.

Acknowledgement

The authors are thankful for the facilities provided by College of Community Science, Dharwad, while conducting the experiment. The authors are grateful to Dr. Hemalatha, S., Prof. & Head, Department of Food Processing and Technology, B.Tech. (F.T.), Dr. Kasturiba., Prof. & Head, Department of Food Science and Nutrition , College of Community Sciences and Dr. Pushpa Bharati., Prof. & Head, Department of Food Science and Nutrition, B.Tech. (F.T.) for providing laboratory facilities to conduct the experiment.

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