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Effects of cassava starch gel on physical and textural properties of coated yam chips

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Abstract

The objective of this study was to transform two varieties of yam, "Anader" (*Dioscorea cayenensis rotundata*) and "Bètè-Bètè" (*Dioscorea alata*), into industrially viable products. The objective was to produce yam chips coated with cassava starch gel (at concentrations of 2%, 3%, and 4%) with a minimal oil content. Yam slices were blanched at 70°C for one minute, following which they were coated with gels prior to undergoing a frying process. "Anader" (*Dioscorea cayenensis rotundata*) variety was fried at 160°C for a period of ten minutes, while "Bètè-Bètè" (*Dioscorea alata*) variety was fried at 150 °C for the same length of time. Results showed that the coating effectively reduced oil content of the chips while maintaining an adequate water content. Oil content of the uncoated chips (control) was found to be 35.71±0.07% for "Bètè-Bètè" (*Dioscorea alata*) and 25.10±0.10% for "Anader" (*Dioscorea cayenensis rotundata*), respectively. However, oil content of the chips coated at 4% was 31.83±0.13% and 24.54±0.04% for the same varieties, respectively. Furthermore, the greatest reduction rates were achieved with 4% cassava starch gel, resulting in a 10.86±0.20% reduction for "Bètè-Bètè" (*Dioscorea alata*) variety. Texture parameters (hardness, fracturability and deformation) also exhibited notable discrepancies in accordance with the varying gel concentrations employed. Cassava starch gel reduced oil absorption and improved the texture of the chips, enhancing their quality. Finally, this easy-to-use, based on local resources, coating makes yam chips healthier and more appealing to health-conscious consumers.

Keywords: Yam; Cassava starch gel; Yam chips; Oil reduction; Coating

1. Introduction

Yams are the main non-cereal food crop in Côte d'Ivoire, with production exceeding 7 million tonnes on an area of more than 990,000 hectares [1]. Yam varieties in Côte d'Ivoire differ in terms of consumer food preferences. Studies have shown that consumers prefer *Dioscorea cayenensis-rotundata* varieties to *Dioscorea alata* because of the quality criteria for fresh tubers [2]. However, *Dioscorea alata* varieties are less appreciated in their traditional forms of consumption (pounded and boiled), particularly at the time of harvest [3].

Frying is often chosen as a method for creating unique flavours and textures in processed foods, enhancing their overall palatability. Frying is a widely used food process that essentially involves immersing pieces of food in hot vegetable oil. It relies on the transfer of heat from the hot oil to the food, resulting in the elimination of water and the absorption of oil [4], [5]. Studies [6] have indicated that as the food material fries, the internal moisture is converted to steam, causing a pressure gradient and, as the surface dries, the oil adheres to the surface of the product and penetrates the surface in damaged areas.

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Chips are deep-fried products. They are thin and therefore have a low water content, making them easy to store and distribute. However, in response to growing consumer health concerns [7], the trend towards healthier, low-fat food products and the high fat content of fried products (35-45%) [8], intensive research has been undertaken to reduce the amount of fat absorbed in fried foods. These techniques include modification of size and thickness [6], pre-drying [9], modification of frying techniques [10], frying medium [11], cooking temperature [12] and chip coating [4].

In edible coatings, a thin layer of edible material applied to the surface of the food product creates a semi-permeable barrier to gases, water vapour, and volatile compounds [13]. Additionally, coating formulations enhance the barrier properties of the fried slices, preventing the formation of pores and cracks in the fried product [14]. Several authors have demonstrated the effectiveness of hydrocolloid-based coatings such as gums (guar and xanthan), pectin, cellulose derivatives such as methylcellulose, hydroxypropylcellulose and carboxymethylcellulose, proteins and other polysaccharides [7], [13], [15].

An edible coating based on cassava starch would be a promising alternative for reducing the oil content of yam chips. The aim of this study is to develop yam chips coated with cassava starch gel and to assess the ability of the coating to reduce the amount of oil.

2. Materials et methods

2.1. Materials

The yam species *Dioscorea alata*, commonly referred to as "Bètè-Bètè," and a yam variety of the species *Dioscorea cayenensis rotundata*, commonly known as "Anader," were procured from a local market. The manioc roots (*Manihot esculenta* Crantz), which were used to make gel coatings, came specifically from the Olékanga variety. The roots were harvested when they had reached maturity, which was 12 months after the cuttings had been planted.

2.2. Methods

2.2.1. Extracting and preparing cassava starch gel

Cassava starch was extracted using the method described in [16]. After peeling the roots and cut into pieces approximately 10 cm in length, they were ground using an electric grinder (Silver crest, SC-1586, USA) and mixed with water. The ground material was filtered through a series of sieves with mesh sizes of 500, 250 and 100 µm respectively to obtain the starch milk. The milk was then subjected to several cycles of decanting and washing cycles before being dried at 48°C for 48 hours. After drying, the starch was milled and stored at room temperature.

The gel was first prepared by homogenizing cassava starch and water in different proportions (2%, 3% and 4%), with the addition of 30% glycerol (w/w, starch mass). The mixture was heated gradually from 30°C to 95°C for 1 hour on a hot plate to form a gel [17].

2.2.2. Coating and frying yam chips

Yam chips were prepared following the steps indicated in the manufacturing diagram developed in this study. The yam tubers were washed in water, peeled, and cut into 1 mm thick strips using a kitchen mandolin. The strips were then drained, patted dry, and blanched at 70°C in water for 1 minute. The blanched strips were then coated. These slices were coated by immersing them in the gel with different concentrations of cassava starch, i.e., 2%, 3% and 4%, for 30 seconds. A control batch of bleached slices from each yam variety was not coated during this study.

The coated slices were then drained and fried in refined palm oil in an electric fryer (NASCO, DF7703-GS, Ghana). The frying parameters involved immersing 730 g of yam slice in 6 L of oil. The frying time-temperature pairs for "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) yams were 10 min-150°C and 10 min-160°C respectively. Finally, the chips obtained were cooled to room temperature before testing.

2.2.3. Physicochemical analysis of chips

Moisture content

Moisture content of coated and uncoated chips was determined using method [18]. A two-gram sample of chips was cooled and placed in an oven (BIOBASSE, BOV-T105F, China) at 105°C for 24 hours. Moisture content was calculated according to the following equation:

$$M\ (\%) = (\frac{m_{bd} - m_{ad}}{m_{bd}}) \times 100 \ldots\ldots\ldots\ldots\ldots(1)$$

M: Moisture content; mbd: mass of chips before drying; mad: mass after drying

Oil content of chips and rate of oil absorption reduction

The oil content of the various types of chips was determined by means of Soxhlet extraction, as outlined in [18]. The 10 g samples were briefly dried and placed in a thimble and extracted with hexane (BP 40-60°C), which was used as a preliminary solvent in the Soxhlet. The solvent was recovered at the end of the extraction process. The oil in the flask was oven-dried to constant weight, and the oil content was determined gravimetrically using the following equation:

$$OC(\%) = \frac{m_{vo} - me_v}{m_s} \times 100 \ldots\ldots\ldots\ldots(2)$$

OC: Oil content; mvo: mass of the vial + oil; mev: mass of the empty vial; ms: mass of the sample.

Reduced Oil Absorption (ROA) of coated chips was determined using the calculation formula proposed by [13].

$$ROA\ (\%) = \frac{OC_T - OS_E}{OC_T} \times 100 \qquad \ldots\ldots\ldots\ldots(3)$$

ROA: Reduced Oil Absorption; OCT: Oil content of control; OSE: Oil content of coated chips.

2.2.4. Texture of coated and uncoated chips (hardness, fracturability and deformation)

A compression test was used to assess the texture of the chips. The test used a Brookfield CT3 texture analyser with a 5 mm knife blade probe at a constant speed of 1 mm/s, following the methodology of [13]. The instrument was equipped with a 100 g load cell. The chips were further compressed in a single-cycle test using a 50 mm plate at a rate of 1 mm/s and compressed to a 4 mm depth. The texturometer provided the fracturability and deformation values.

Force-deformation curves were obtained, and hardness parameters were evaluated as follows:

$$H\ (N/mm) = \frac{\text{maximum Force (N)}}{\text{maximale Deformation (mm)}} \ldots\ldots\ldots\ldots(4)$$

To eliminate external variations, the experiments were done at room temperature. Each test was repeated five times, and the average was used to show the texture of the chips.

2.2.5. Statistical analysis

Statistical software was used. ANOVA was used to compare the means of the different concentrations of cassava starch in each variety and a 5% threshold was used to differentiate the means. T-test was used to compare the two types of chips.

3. Results

3.1. Effect of coating on physicochemical properties of yam chips

3.1.1. Moisture content

Moisture content of yam chips coated with varying concentrations of cassava starch gel is presented in Table 1 of the study. The results demonstrated a statistically significant difference ($P < 0.05$) in moisture content of the chips across all yam varieties, irrespective of the coating gel concentration. Furthermore, moisture content of the uncoated chips (control) was found to be lower than that of the coated chips, with a significant difference ($P < 0.05$) observed for all yam varieties. Furthermore, the 4% cassava starch gel treatment exhibited the highest moisture content values, with 7.06±0.27% for the "Bètè-Bètè" variety (*D. alata*) and 5.82±0.16% for the "Anader" variety (*D. cayenensis rotundata*).

In addition, the comparison of the two varieties revealed a significant difference ($P < 0.05$) between moisture content of the control chips and the chips coated with 3% and 4% cassava starch gel. Nevertheless, no significant difference (P

> 0.05) was observed between the contents of chips coated with 2% gel, with values of 4.22±0.04% and 4.03±0.20% respectively for the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties.

Table 1 Moisture content of coated and uncoated yam chips of the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties

Yam varieties	Moisture content (%)			
	Chips			
	T	$F_{C=2\,\%}$	$F_{C=3\,\%}$	$F_{C=4\,\%}$
"Bètè-Bètè"	1.78±0.22^{a*}	4.22±0.04^{b*}	5.54±0.21^{c**}	7.06±0.27^{d**}
"Anader"	2.67±0.28^{a**}	4.03±0.20^{b*}	4.73±0.11^{c*}	5.82±0.16^{d*}

Mean ± SD. The values in the same row with the same letter are significantly different at the 5% level according to Duncan's ANOVA test. * = significantly different at the 5% level according to Student's t-test. T: uncoated yam chips (control); FC=2%: yam chips coated at 2%; FC=3%: yam chips coated at 3%; FC=4%: yam chips coated at 4%.

3.1.2. Oil content of chips and rate of oil absorption reduction

Table 2 shows Oil content and absorption rate of coated and uncoated yam chips from the two yam varieties. Oil content of uncoated and coated yam chips differs significantly ($p < 0.05$), regardless of yam variety. Oil content of the coated chips was lower than the uncoated controls, regardless of variety. Yam chips coated with 4% cassava starch gel had the lowest oil content. For "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*), values were 31.83±0.13% and 24.54±0.04% respectively. Data was lower in the chips coated with 4% cassava starch gel than in those coated with 2% and 3%. Oil content of the two types of chips differed significantly ($p < 0.05$). "Bètè-Bètè" (*D. alata*) varieties have higher oil contents than "Anader" (*D. cayenensis rotundata*) varieties. Oil content of chips coated at 4% is 31.83±0.13 % and 24.54% for "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*). Oil content of the chips differed significantly between the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties. "Bètè-Bètè" (*D. alata*) chips have more oil than "Anader" (*D. cayenensis rotundata*).

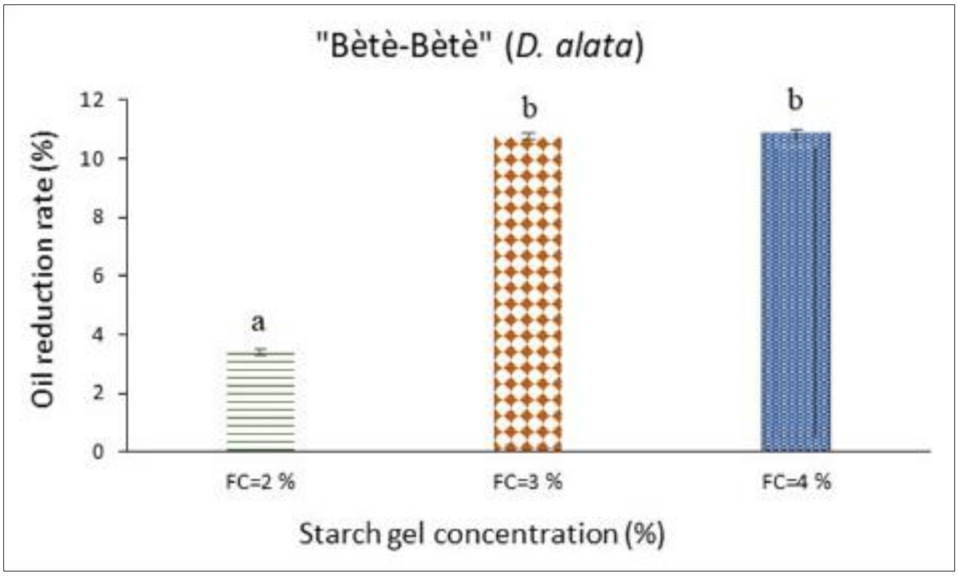
Oil absorption rates were also different for the yam varieties (Figure 1 and 2). The highest reduction rates were obtained using cassava starch gel at 4%. The rates for the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties were 10.86% and 3.04%, respectively. There was a significant difference between the varieties ($p < 0.05$). The highest rates were obtained with "Bètè-Bètè" chips (*D. alata*) (Figure 3).

This study showed that oil absorption in chips of the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties was reduced by 3.38% to 10.86% and by 1.02% to 3.04%, respectively.

Table 2 Oil content of coated and uncoated yam chips from "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*)

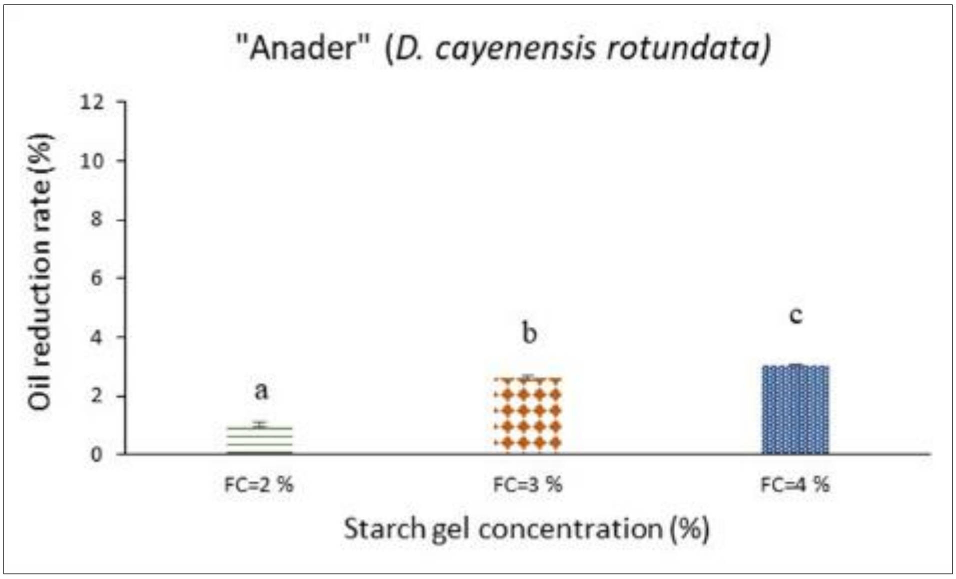
Yam varieties	Oil content (%)			
	Chips			
	T	$F_{C=2\,\%}$	$F_{C=3\,\%}$	$F_{C=4\,\%}$
"Bètè-Bètè"	35.71±0.07^{b**}	34.50±0.10^{b**}	31.87±0.22^{a**}	31.83±0.13^{a**}
"Anader"	25.31±0.10^{c*}	25.05±0.07^{b*}	24.65±0.08^{a*}	24.54±0.04^{a*}

Mean±SD. The values in the same row with the same letter are significantly different at the 5% level according to Duncan's ANOVA test. * = significantly different at the 5% level according to Student's t-test. T: uncoated yam chips (control); FC=2%: yam chips coated at 2%; FC=3%: yam chips coated at 3%; FC=4%: yam chips coated at 4%.



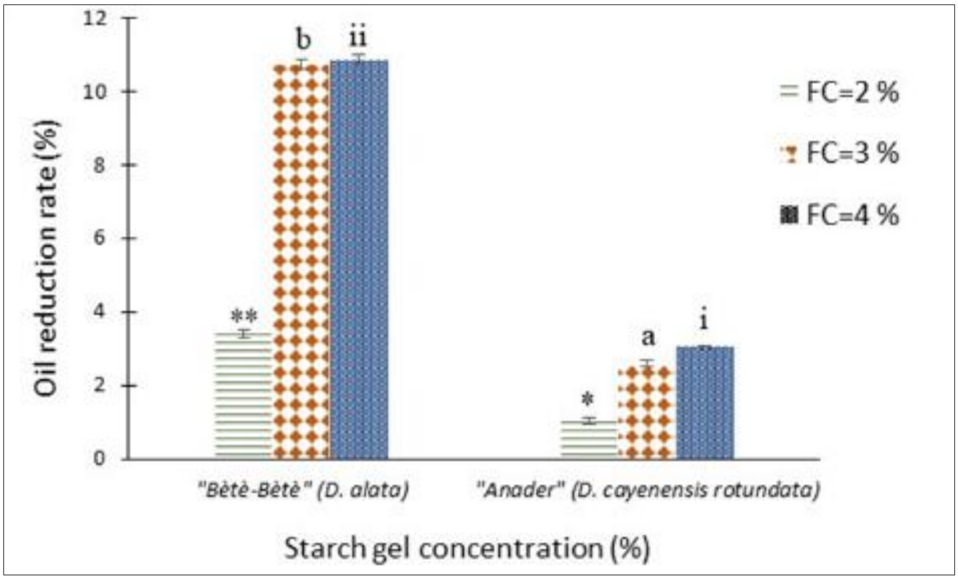
Concentrations assigned distinct letters are significantly different at the 5% level according to Duncan's ANOVA test. T: uncoated yam chips (control); FC=2%: yam chips coated at 2%; FC=3%: yam chips coated at 3%; FC=4%: yam chips coated at 4%.

Figure 1 Reduced Oil Absorption of coated yam chips of "Bètè-Bètè" variety (*D. alata*)



Concentrations assigned distinct letters are significantly different at the 5% level according to Duncan's ANOVA test. T: uncoated yam chips (control); FC=2%: yam chips coated at 2%; FC=3%: yam chips coated at 3%; FC=4%: yam chips coated at 4%.

Figure 2 Reduced Oil Absorption of coated yam chips of "Anader" (*D. cayenensis rotundata*) variety



The distinct signs *, ** assigned to the 2% concentration are significantly different according to Student's t-test at the 5% level according to Student's t-test. Letters a and b assigned to the 3% concentration are significantly different. Signs i and ii assigned to the 4% concentration are significantly different according to Student's t-test at the 5% level. FC=2%: coated yam chips at 2%; FC=3%: yam chips coated at 3%; FC=4%: yam chips coated at 4%.

Figure 3 Comparison of oil absorption reduction rates of two coated variety yam chips: "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*)

3.2. Effect of coating on texture properties of yam chips

Texture parameters show a significant difference (p<0,05) between coated and uncoated chips of different varieties. The hardest chips were coated with 2% and 3% cassava starch gel for the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties, with respective hardnesses of 2.22±0.15 N/mm and 5.43±1.83 N/mm. Regarding the comparison between different varieties, data hardnesses showed no significant difference (p>0.05) for yam chips coated with 2% starch gel, while a significant difference (p<0,05) was observed for control chips and those coated with 3% and 4% starch gel.

Furthermore, a significant difference (p<0,05) was observed between the two varieties of chips, with the yam varieties displaying distinct textural characteristics. Table 3 illustrates evolution of texture parameters in yam chips of different varieties, coated and uncoated with cassava starch gel.

Table 3 Texture of yam chips of "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties

Yam varieties	Hardness		Fracturability		Deformation	
	"Bètè-Bètè"	"Anader"	"Bètè-Bètè"	"Anader"	"Bètè-Bètè"	"Anader"
T	1.540±0.272[a*]	2.193±0.107[a**]	2.510±0.052[b*]	6.183±2.027[b**]	1.470±0.152[ab*]	2.470±0.160[a**]
$F_{C=2\,\%}$	2.223±0.155[b*]	2.620±0.671[a*]	3.576±0.616[a*]	5.906±0.777[ab**]	1.133±0.152[a*]	2.076±0.152[c**]
$F_{C=3\,\%}$	1.140±0.160[a*]	5.430±1.837[b**]	2.996±0.290[ab*]	4.69±0.920[ab**]	1.906±0.195[b*]	1.133±0.152[b*]
$F_{C=4\,\%}$	1.376±0.299[a*]	2.166±0.254[a**]	3.846±0.683[a*]	3.636±0.156[a*]	1.236±0.055[a*]	2.110±0.200[a**]

Mean±standard deviation. Values in the same column with alphabetical letters are significantly different at the 5% level according to Duncan's ANOVA test. Values in the same row marked with *, ** and *** are significantly different at the 5% level according to Student's t-test. T: uncoated yam chips (control); FC=2%: coated yam chips at 2%; FC=3%: yam chips coated at 3%; FC=4%: yam chips coated at 4%.

The highest fracturability values were 3.84±0.68 N and 6.18±2.02 N for chips coated with 4% cassava starch gel and uncoated chips (control) in the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties. The highest deformation values were 1.90±0.19 mm and 2.47 ±0.16 mm. The results were obtained with chips coated with 3% cassava starch gel and uncoated (control) for the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties. In addition, there was no significant difference in fracturability (p>0.05) between chips uncoated (control) and coated with 2% and 3% cassava starch gel when comparing varieties. However, there was a significant difference between yam chips coated with 4% cassava starch gel. Deformation differed significantly between the two varieties ($p < 0.05$) when comparing uncoated chips (control) with chips coated with 2% and 4% cassava starch gel. This study found that "Anader" (*D. cayenensis rotundata*) varieties had higher fracturability and deformation values at the control level. These values were lower for coated and uncoated "Bètè-Bètè" (*D. alata*) chips.

4. Discussion

Moisture content of a foodstuff is a parameter that influences the quality and efficiency of frying, the amount of oil absorbed, and the texture of the resulting product. In this study, the cassava starch gel coating was observed to retain moisture in the yam chips. As posited by [19] and [13], this phenomenon can be attributed to the coating's capacity to retain water present in the coated chips. The coating thus serves to enhance the barrier property, thereby preventing the formation of pores and cracks in fried chips. During the frying process, water is transported from the interior of the product to its surface, where it is removed and replaced by oil. This phenomenon has been observed in the context of fried chips coated with a cassava gel and glycerol mixture. Chips coated with 4% starch gel exhibited higher moisture content, consistent with the findings of [20]. The discrepancy observed in the coated chips can be attributed to the 4% starch gel's pivotal role in establishing a robust barrier and impeding the formation of pores and cracks in the fried chips.

The observed differences in water content between yam varieties may be attributed to several factors, as proposed by [15]. These characteristics include the initial water content of the raw material, the diameter of the products, and the time/temperature ratio. Another factor that may have contributed to the observed differences is the variation in frying temperature employed in this study, with 150°C used for the "Bètè-Bètè"variety (*D. alata*) and 160°C for the "Anader" (*D. cayenensis rotundata*) variety. These findings align with those of [21] and [15], who conducted similar studies on banana chips. Moreover, the similar water content in chips coated with 2% starch for both varieties suggests that the coating at this concentration is likely independent of yam variety. This could help optimize coating parameters based on the specific properties of each yam variety.

The findings of this study indicated that the coating reduced the oil content in yam chips. This reduction can be attributed to the efficacy of the coating in preventing the ingress of oil into the chips. The formation of a coating film prevents the penetration of oil into the cavities formed during the frying process. Furthermore, the coating can enhance the surface smoothness of the chips and reduce the number of passes required during frying, which in turn minimizes water evaporation and oil absorption [19]. This barrier also impedes the evaporation of water, preventing its replacement by oil in the chips [22]. Moreover, [15] posited that when the water content is elevated, the oil content is diminished. Our findings align with those of [23] and [19], who posited that enhanced adhesion to the chip surface may be attributed to the efficacy of the 4% gel coating.

The difference in oil content between varieties may be due to the variation in frying temperature, identified as key factor influencing oil absorption in chips [24]. The values obtained in this study are relatively low. As stated by [25], a minimal oil content can result in a crisp that is both brittle and unappealing, while an excess of oil can cause the product to become soggy, leading to its rejection by consumers. Furthermore, health-conscious consumers may be reluctant to consume products with a high oil content due to the influence of consumer trends and nutritional knowledge on product choice. There is a well-established link between fat type and coronary heart disease (CHD), which may influence consumer decisions regarding the consumption of foods with high fat content [26].

The reduction in oil absorption observed in this study may be influenced by several factors, including the temperature and duration of frying, as well as the concentration of coating gel. Indeed, [15] have stated that an increase in frying temperature results in a reduction in oil content, which is corroborated by the findings of this study. Furthermore, an excess of oil in food items has been demonstrated to have a deleterious impact on their shelf life, due to the heightened risk of oxidative rancidity [27].

Hardness is defined as the ratio of the maximum force applied to the sample to the maximum deformation just before chip breakage or fracture. This ratio is expressed in units of N/mm [28]. The findings of this study suggest that an increase in water content and gel concentration of cassava starch is associated with a reduction in hardness. This may be attributed to the diameter of the chips and the initial composition of the chips. Indeed, starch is one of the most significant chemical components that influence the texture quality of chips during processing [29]. [30] reported that coating at different concentrations enabled the maintenance of acceptable levels of textural attributes. Moreover, [22] have demonstrated that the hardness of yam varieties is dependent on the cooking temperature. The objective of their study was to investigate the effect of osmotic sucrose treatment on the moisture, texture, antioxidant, and sensory properties of coconut chips immersed in ginger extract. The findings of this study indicate that an increase in water content and gel concentration results in a reduction in deformation and fracturability. These results may be attributed to the chemical composition of the gel concentrations on the surface of the chips [22], although it has been asserted that a reduction in water content is associated with an increase in deformation and fracturability. In the context of this study, the term 'strain' refers to the change in peak force (measured in millimeters) caused by fracturability just before a sample breaks or fractures in compression tests. It can be observed that materials which exhibit the same peak force may display either higher hardness or lower deformation. This indicates that the material in question is more brittle or less flexible. The findings demonstrate the significance of coating concentration, moisture content and processing conditions. The moisture content of a material has a significant impact on its maximum strength value. The lower the moisture content of a material, the higher its fracturability value, as evidenced by the data obtained from the yam varieties [31]. In conclusion, our findings align with those of [15] on low-fat banana chips.

5. Conclusion

The study demonstrated the efficacy of employing a coating based on cassava starch gel to produce yam chips belonging to the "Bètè-Bètè" (*D. alata*) and "Anader" (*D. cayenensis rotundata*) varieties, characterized by a minimal oil content. The results indicated that the incorporation of cassava starch gel led to a notable reduction in the oil content of the chips derived from the two yam varieties. The coating demonstrated two major beneficial effects: the retention of moisture in the chips and a significant reduction in oil absorption during frying. A comparative study of coated and uncoated chips demonstrated a significant reduction in oil content for the two yam varieties under investigation, without any impact on the organoleptic qualities of the final product. This reduction in fat content aligns with the growing consumer demand for healthier alternatives to traditional chips. Furthermore, the use of a coating based on cassava starch represents a promising approach to produce low-fat chips. This innovation responds to the current challenges facing the food industry in terms of public health and consumer demand for healthier options.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no known financial conflicts of interest or personal relationships that might have appeared to influence the work reported in this article.

References

[1] A. Coulibaly, C. Degbeu, A. A. Doh, and A. N'Guessan, Étude de la stabilité de quelques propriétés physico-chimiques des tranches d'igname congelées (*Dioscorea cayenensis-rotundata* cv Kponan) de Côte d'Ivoire et analyse sensorielle des mets dérivés, *J. Appl. Biosci.*, vol. 158, p. 16310-20, 2022.

[2] C. Nindjin, D. A. Otokoré, S. T. Hauser, Z. Farah, and O. Girardin, Determination of relevant sensory properties of pounded yams (*Dioscorea spp.*) using a locally based descriptive analysis methodology, *Food Qual. Prefer.*, vol. 18, pp. 450–459, 2007.

[3] A. Tschannen, M. Touré, P. S. Stressens, D. Dao, C. Nindjin, and O. Girardin, Technologie post récolte de l'igname (*Dioscorea spp.*) : adaptation de l'application de l'acide gibbérellique aux conditions paysanes, *Agron. Afr.*, vol. 4, p. 83-90, 2003.

[4] S. R. Calliope, A. M. Slavutsky, N. Segura, and N. C. Samman, Application of an edible coating developed with Andean potato starch and carboxymethyl-cellulose for lipid reduction during frying, *Grasas Aceites*, vol. 74, no. 4, p. e529, Dec. 2023, doi: 10.3989/gya.0103231.

[5] H. I. Khalil and I. Ashoush, Reduction of oil content from fried potato crisps: Kinetics of moisture loss, oil uptake and color changes during frying, *Ann. Agric Sci Ain Shams Univ*, vol. 53, pp. 195–206, Jan. 2008.

[6] M. H. Gamble, P. Rice, and J. D. Selman, Relationship between oil uptake and moisture loss during frying of potato slice from cv Record UK Tubers, *Int. J. Food Sci. Technol.*, vol. 22, pp. 233–241, 1987.

[7] K. S. Abbasi *et al.*, Quality of potato chips as influenced by Aloe vera coating, *J. Food Nutr. Res.*, vol. 3, no. 3, pp. 157–161, 2015.

[8] Y. Liu, T. Jianjun, Z. Tingting, and F. Liuping, Effects of frying temperature and pore profile on the oil absorption behavior of fried potato chips, *Food Chem.*, vol. 345, p. 128832, 2021.

[9] F. Pedreschi and M. Pedro, Effect of pre-drying on texture and oil uptake of potato chips, *Food Sci. Technol.*, vol. 38, no. 6, p. 599-604, 2005.

[10] U. Mehta and B. Swinburn, A review of factor effecting fat absorption in hot chips, *Crit. Rev. Food Sci. Nutr.*, vol. 44, pp. 133–154, 2001.

[11] S. K. Berry, R. C. Sehgal, and C. L. Kalra, Comparative oil uptake by potato chips during frying under different conditions, *J. Food Sci. Technol.*, vol. 36, pp. 519–521, 1999.

[12] M. Mellema, Mechanism and reduction of fat uptake in deep-fat fried foods, *Trends Food Sci. Technol.*, vol. 14, no. 9, p. 364-373, 2003.

[13] A. Rezagholizade-Shirvan, K. Mahboubeh, and R. A. Mohammad, Evaluation of the effect of basil seed gum, tragacanth gum, pectin, and coating formulation with corn flour on oil absorption and sensory properties of watermelon rind chips, *Heliyon*, vol. 9, no. 6, p. e16976, 2023.

[14] Y. Su, Z. Min, C. Bimal, and Z. Weiming, Reduction of oil uptake with osmotic dehydration and coating pre-treatment in microwave-assisted vacuum fried potato chips, *Food Biosci.*, vol. 9, p. 100825, 2021.

[15] J. S. P. dos Santos, L. Magali, R. R. de J. Paulo, L. Sarita, M. F. Adalton, and F. dos O. Lucas, Hydrocolloid coatings as à pre-frying treatment in the production of low-fat banana chips, *Horticulturae*, vol. 9, no. 10, p. 1139, 2023.

[16] N. G. Amani, A. Buléon, A. Kamenan, and P. Colonna, Variability in starch physicochemical and functional properties of yam (*Dioscorea sp*) cultivated in Ivory Coast, *J. Sci. Food Agric.*, vol. 84, no. 15, pp. 2085–2096, Dec. 2004, doi: 10.1002/jsfa.1834.

[17] Y. D. Adjouman, C. Nindjin, F. A. Tetchi, A. C. Dalcq, and G. Amani, Water vapor permeability of edible films based on improved cassava (*Manihot esculenta* Crantz) native starches, *J. Food Process. Technol.*, vol. 08, no. 03, p. 6, 2017, doi: 10.4172/2157-7110.1000665.

[18] W. Horwitz and G.W. Latimer, Official Methods of Analysis of AOAC INTERNATIONAL, *J. AOAC Int*, 2005, 18th Ed., AOAC IN TER NATIONAL, Gaithersburg, MD, USA, Offi cial Method 2005.08, p26

[19] L. Yu, J. Li, S. Ding, F. Hang, and L. Fan, Effect of guar gum with glycerol coating on the properties and oil absorption of fried potato chips, *Food Hydrocoll.*, vol. 54, pp. 211–219, Mar. 2016, doi: 10.1016/j.foodhyd.2015.10.003.

[20] S. Mali, M. V. E. Grossmann, M. A. García, M. N. Martino, and N. E. Zaritzky, Barrier, mechanical and optical properties of plasticized yam starch films, *Carbohydr. Polym.*, vol. 56, no. 2, pp. 129–135, Jun. 2004, doi: 10.1016/j.carbpol.2004.01.004.

[21] M. Pinzón, L. M. Jairo, and C. A. L. Juan, Evaluation of quality parameters of chips 12 varieties of bananas aab genotype under deep frying, *Vitae*, vol. 23, pp. 531–535, 2016.

[22] K. Kawiji, A. H. J. Siahaan, G. J. Manuhara, and W. Atmaka, Sucrose osmotic treatment effect on moisture, antioxidant, texture, and sensory properties of ginger extract-imersed coconut chips, *J. Appl. Agric. Sci. Technol.*, vol. 8, no. 2, Art. no. 2, May 2024, doi: 10.55043/jaast.v8i2.246.

[23] A. D. Garmakhany, H. O. Mirzaei, M. K. Nejad, and Y. Maghsudlo, Study of oil uptake and some quality attributes of potato chips affected by hydrocolloids, *Eur. J. Lipid Sci. Technol.*, vol. 110, no. 11, pp. 1045–1049, 2008, doi: 10.1002/ejlt.200700255.

[24] A. Kita, G. Lisińska, and G. Gołubowska, The effects of oils and frying temperatures on the texture and fat content of potato crisps, *Food Chem.*, vol. 102, no. 1, pp. 1–5, Jan. 2007, doi: 10.1016/j.foodchem.2005.08.038.

[25] G. Abong, J. Ogolla, O. Michael, K. Jackson, and K. Paul, Effect of frying temperature and slice thickness on sensory attributes and acrylamide content in potato crisps of selected Kenyan varieties, *East Afr. J. Sci. Technol. Innov.*, vol. 4, Aug. 2023, doi: 10.37425/eajsti.v4i.737.

[26] F. B. Hu *et al.*, Dietary fat intake and the risk of coronary heart disease in women, *N. Engl. J. Med.*, vol. 337, no. 21, pp. 1491–1499, Nov. 1997, doi: 10.1056/NEJM199711203372102.

[27] E. Wąsowicz *et al.*, Oxidation of lipids in food, *Pol. J. Food Nutr. Sci.*, vol. 54, no. 1, pp. 87–100, 2004.

[28] M. Tran and X. Chen, Improving the physical properties crunchiness of potato crisps by pretreatment techniques and vacuum frying, *Proc SPIE*, vol. 8793, p. 07, Aug. 2013, doi: 10.1117/12.2028202.

[29] A. Kita, The influence of potato chemical composition on crisp texture, *Food Chem.*, vol. 76, no. 2, pp. 173–179, Feb. 2002, doi: 10.1016/S0308-8146(01)00260-6.

[30] M. A. García, C. Ferrero, N. Bértola, M. Martino, and N. Zaritzky, Edible coatings from cellulose derivatives to reduce oil uptake in fried products, *Innov. Food Sci. Emerg. Technol.*, vol. 3, no. 4, pp. 391–397, Dec. 2002, doi: 10.1016/S1466-8564(02)00050-4.

[31] A. B. Oyedeji *et al.*, Effect of frying treatments on texture and colour parameters of deep fat fried yellow fleshed cassava chips, *J. Food Qual.*, vol. 2017, no. 1, p. 8373801, 2017, doi: 10.1155/2017/8373801