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EXTRACTION AND INVESTIGATION OF SWEET POTATO PEEL(IPOMOEA BATATAS) STARCH AS AN ANTI-CAKING ADDITIVE AND VALUE ADDITION WITH POWDERED SUCROSE CRYSTALS BLEND.

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Abstract

Applications of sweet potato starch have been extensively and globally engaged in various technical and industrial value-added products. The peels, perceived as domestic waste have always been underexploited and neglected as its reuse been limited to animal feeds overtime. Hence, a strong rationale in the adoption of sweet potato peels starch (SPPS) as an additive and anti-caking agent with powder sucrose (PS) as extensively used in confectionery products has been investigated.
The extracted product was defined by its identity, sensory, physical and chemical properties.
Positive iodine test for starch, odour ,taste, pH(6.5),moisture content (8.28%),bulk density(1.70g/ml),tapped density(0.87g/ml), angle of repose(78o),carr's index(23.05), hausner's ratio(1.51), amylase content(21.34%), water-binding capacity (2.14) and gelatinizing temperature (65o) were the parameters studied with the extracted starch.
Furthermore, eleven blends (SPPS + PS) were developed and comparatively analyzed with pH, total dissolved solids (TDS), electrical conductivity (EC), bulk (BD) and tapped density (TD) with respect to control product.Blend B [2%SPPS & 98%PS] (pH=7.0, TDS= 47ppm, EC=0.047uS/cm, TD=2.56g/ml, BD= 0.83g/ml) and C [3%SPPS & 97%PS] (pH=6.8, TDS=52ppm, EC=0.052uS/cm, TD=2.70g/ml, BD=0.80g/ml) are relatively closer with the same properties of the control [3%SPPS & 97%] (pH=6.7, TDS=53ppm, EC=0.050uS/cm ,TD=2.67g/ml, BD=0.77g/ml).
Hence, with mild chemically modified approach especially in the aspect of powder flowability and compressibility, starch from potato peels can serve as a good anti-caking and anti-oxidant agents especially in food industries and material science.

Keyword: Sweet potato, value addition, and anti-caking agents

1.INTRODUCTION

Starch significantly compliments as an additive to the properties of most organic and inorganic material. It is an additive that is widely embraced for different applications as a colloidal preservative and thickening agent [1].

Be that as it may, limitations such as low protection from shear quality limit its use in some modern applications as it decides nutritional quality, dietary benefit, and shelf life.[2]

Retro- degree (retro degradation) procedure represents the modification that happens on cooling with the activity of the starch product, where amylose and amylopectin compositions reassociate and restructured. Amylose - amylopectin portrays the gelatinization process, which results as starch granules are heated and communicated as the breaking down of sub-atomic or monomeric fractions of the starch.

By this procedure, starch granules swell and restructure the gel particles [2]. The swollen granules are mostly amylopectin, where amylose structures are the final constant gel stage outside the granules. Parameter like amylose content, granule size, volume, shape, and constant stage thickness rely upon rheological or gluing conduct of the starch. [3]. Food wastes management is a striking enterprise over the globe with results of fundamentally natural material that must be overseen appropriately so as to checkmate environmental hazards [4].

Sanitation and technical management of food wastes compel and enable numerous methodologies like reusing such waste biomass by adding value and conversion into renewed biodegradable resources. Such results for sustenance and control of organic wastes are an important material for the generation of significant biobased products like biopolymers, cancer prevention agents, anticaking control and sources of dietary fiber.

Generally, sweet potato is the fourth most significant agricultural produce following rice, wheat, and corn. It is the most widely recognized source of food wastes being generated from its various forms of consumption [5]. Meanwhile, the most well-known source of environmental contamination is identified with natural decomposition and deterioration of most organic wastes which happens when bacterial and other organic microorganisms used them up as a source of energy [6]. Hence, in a bid to counter such crisis, utilization or application of sweet potato peels has been exploited as a cancer prevention agent in nutritional frameworks because of its high phenolic arrangement[7] and also, as feed for pigs [8]. In any case, it is not suitable for any extra modifications as feed for non-ruminants since it is exceptionally sinewy for them to be processed biochemically [8]. Alternatively, it has been adequately utilized in the bolstering of multi-gastric animals [9].

Milk fat from bovines bolstered with sweet potato peels was accounted for to be 3.3 g/kg higher than that of control [10]. The demand and human consumption of sweet potato, since it is broadly acknowledged for its nutraceutical properties inferable from cell reinforcement exercises, as a result of extraordinary compositions of anthocyanins, carotenoids, flavonoids, and other phenolic groups has been in the increase [7]. The concentrate of sweet potato peels had both bactericidal and bacteriostatic impacts at a high focus[7]. Along these lines, potato peels were proposed as a conceivable sheltered, with characteristic cell reinforcement nutritionally.

Anticaking agents are fundamentally starch additives that are added or blended with other powdered substances or granulated materials disallowing clumping or agglomeration of the intraparticle of the materials. They behave either by adsorbing water vapor (moisture) or by blending with particles and making them hydrophobic. Some are miscible in water; others in alcohol or organic solvents. Calcium silicate ($CaSiO_3$), a regular anti-caking agent that adds to table salt, adsorbs water and oil.

They are traditionally used in non-food products such as road salt, fertilizers, cosmetics, synthetic detergents, and other manufacturing applications. They thusly avert the development of irregularities that makes the powder (food product) sample reasonable for bundling, transport, and for use by the end consumer.

Objectively, the task is to study the behavior of the raw starch isolated from wasted sweet potato peels with sucrose (sugar) powdered crystals with respect to commercial confectionary sucrose crystals with the composition of 3% anticaking agents and 97% sucrose powder [11].

2.MATERIALS AND METHOD

2.1. Extraction of Starch from sweet potato peels.

The wasted sweet potato peels vapor from local sweet potato chips trader. The method of starch extraction was according to Soebagio et al. [12]. The species of sweet potato used is called "Hannah" (labeled D). It has tan skin and an off-white interior (Figure 1). It was weighed, cleansed with distilled water into small pieces and then was homogenized with distilled water containing 0.3%sodium metabisulphites at a quantity of sweet potato peel to distilled water (1:2, w/v). The resulting homogenized mixture was filtered, squeezed using a sieve cloth till dryness, and separated into a container. The filtrate was kept undisturbed for 24 h, resulting in a complete starch residue. The starch was separated by careful decantation and was eventually dried in an oven at 60ºC for 24 h. Drying continues until the extracted starch attained a constant mass. The dried starch was then grounded and screened through a 24-mesh sieve.

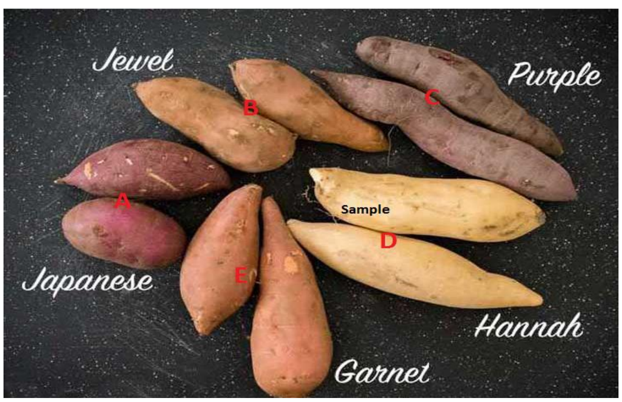

Figure 1. Sweet potato varieties

2.2. Sucrose Milling

Confectionary sugar was acquired from the local store. About 1kg of refining sucrose crystals was ground into fine particle size and sieved through a mesh of 24.

2.3. Characterization of sweet potato starch

2.3.1. Identification Test

A gram of the extracted starch was mixed with 15ml of water and boiled for a few minutes; allow cooling to room temperature. A couple of drops of 0.1N iodine solution were added to 1ml of the starchy solution.

The appearance of blue color indicates the presence of starch which disappears when the solution is boiled and reappears when cooled. [13]

2.3.2 Sensory properties

1 g of starch was weighed and its color, odor, and taste were subsequently observed

2.3.3. Determination of pH

A gram of the starch intraparticle into 100 ml of distilled water and the pH was determined with HI 9813-5 pH meter.

2.3.4 Moisture content determination

2 grams of the starch powder was weighed and afterward dehydrated at 105oC in an oven for an hour interval and re-weighed again until the consistent weight was attained and the level of moisture loss on drying was calculated. [14]

2.5.5 Determination of bulk density, tapped density Carr's index and Hausner ratio

An empty, cleaned and dried measuring cylinder (100 ml) was weighed (W1), then the starch sample was filled up to 100 ml (V0) and the total weight was determined (W2). The measuring cylinder filled with the starch sample was attached to the bulk density tapping apparatus. The start button was activated to tap the measuring cylinder for 500 times. The volume of the starch sample was subsequently measured (V1). The bulk density and tapped density were determined using equation (2) and (3) respectively, while the respective Carr's index and Hausner ratio were calculated. [15]

Bulk density (ρ_{bulk}) = $\frac{W_2 - W_1}{V_1}$

Tapped density (ρ_{tapped}) = $\frac{W_2 - W_1}{V_2}$

Carr's index (%) = $\left\{1 - \frac{\text{bulk density}}{\text{Tapped density}}\right\} \times 100\%$

Hausner ratio = $\frac{\rho_{tapped}}{\rho_{bulk}}$

Table .I Powder character determinant

Compressibility index (%)	Flow character	Hausner's Ratio
1-10	Excellent	1.00-1.11
11-15	Good	1.21-1.18
16-20	Fair	1.19-1.25
21-25	Passable	1.26-1.34
26-31	Poor	1.35-1.45
32-37	Very poor	1.46-1.59
>38	Very, very poor	>1.60

2.3.6. Determination of repose angle of sweet potato peel starch

Some quantity of SPPS was placed into a funnel, in which its base part was shut with a bit of paper. assuming free streaming of the starch, with the shape of a cone and the point of the angle can be resolved. The lower the magnitude of the angle, the better the progression of the powder [16]. This strategy utilized a channel verified with its tip at given tallness (h), over the chart paper put on the flat surface. Starch powders were poured through the channel until the summit of the cone-shaped heap contacts the tip of the pipe. The repose angle was calculated with the relationship below as;

$$\tan \emptyset = h/r$$

Ø denotes the repose angle; r, the radius of funnel used and h, depth of the funnel. This approach is known as a fixed stature technique.

2.3.7. Amylose content (%)

Amylose content of the isolated sweet potato peel starch was estimated using the method of Stawski, D. [17].

2.3.8. Water binding ability

The ability of the extracted sweet potato peel starch to bind with molecules of water was according to the method of Medcalf and Gilles (1965) [18]. A suspension of 5 g starch (dry weight) in 75 ml de-ionized water was stirred for 1 h and at 3000rpm with centrifuge for the period of 10 min. The free water was expelled from the wet starch, which was then allowed to dry for 10 min. The soaked starch was weighed

.

2.3.9. Determination of gelatinizing temperature

10g of the extracted starch was dissolved into 100ml distilled water in 250ml container, and the solution was heated with a water bath to the point of boiling with consistent mixing. The Temperature was recorded after gelatinization as physically observed [19]

2.3.10. Potato peel starch -sucrose blend

Ten blends of the extracted sweet potato starch (SPPS) with powdered sucrose (PS) both at mesh size of 24 were prepared in the order (1% PPS-99%PS), (2%PPS-98%PS), (3%PPS-97%PS), (4%PPS-96%PS), (5%PPS-95%PS), (6%PPS-94%PS), (7%PPS-93%PS), (8%PPS-92%PS), (9%PPS-91%PS) and (10%PPS-90%PS).The blends were characterized with ph, conductivity (EC), dissolved solids per 50ml of blend solution (TDS), bulk density (BD) and tapped density (TD).

3.RESULTS AND DISCUSSION

Table II. Parameters of the extracted sweet potatoPeel starch

Category	Property	Value
Identification Test	Iodine Test for Starch	+
Sensory properties	Colour	Cream
	Odor	Odorless
	Taste	Tasteless
	Form	Powder
Physico-chemical characteristics		
	pH	6.50
	Moisture content (%)	8.16
	Bulk density(g/ml)	1.70
	Tapped density(g/ml)	0.87
	The angle of repose(o)	78
	Carr's index	23.05
	Hausner ratio	1.51
	Amylose content (%)	21.34
	Water binding capacity (%)	2.14
	Gelatinizing Temperature(°C)	65.00

Table III. Selected parameters of sweet potato peel starch with powdered sucrose crystals blends

Blend	SPPS (%) (g)	SP (%) (g)	SPPS+SP(ml) V_1	V_2(ml)	pH	TDS (ppm)	E.C. (uS/cm)	T.D (g/ml)	B.D (g/ml)
A	1	99	100	60.00	7.3	40	0.040	2.50	0.85
B	2	98	100	61.00	7.0	47	0.047	2.56	0.83
C	3	97	100	63.00	6.8	52	0.052	2.70	0.80
D	4	96	100	64.50	6.6	58	0.058	2.82	0.78
E	5	95	100	65.20	6.5	61	0.061	2.87	0.75
F	6	94	100	66.00	6.0	63	0.063	2.94	0.72
G	7	93	100	66.40	5.7	67	0.067	2.98	0.70
H	8	92	100	67.00	5.2	73	0.073	3.03	0.67
I	9	91	100	67.50	4.0	75	0.075	3.06	0.65
J	10	90	100	68.10	3.8	70	0.007	3.14	0.63
CONTROL	3% anticaking agent 97% powder sucrose		100	62.56	6.7	53	0.050	2.67	0.77

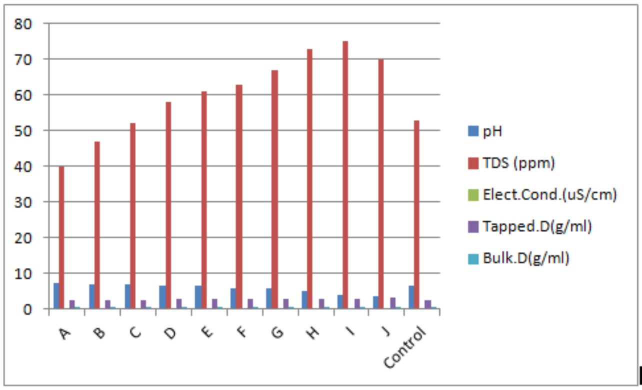

Figure lll. The output of extracted SPPS and PS parameters

As disclosed in table ll, starch was successfully isolated from waste peels of sweet potato peels. Identity tests with iodine and sensory evaluation were declared positive. the pH of 6.5 further justifies the nature of the starch extract according to the claim of starch having a pH range between 4 and 7 [20]. The moisture content of 8.82% quietly discloses other active component such as fiber and Ash contents. Bulk and tapped densities which are the function of particle spatial configuration in a specified volume are 1.70g/ml and 0.87g/ml respectively. The angle of repose, an expression of the steepest angle of descent with respect to the horizontal plane was 78o. This is a value that defines the extracted starch to be fair enough in terms of its flowability. [21]. Similarly Hausner ratio which also states the flowability of the starch powder was 1.51, a value considered to be poor. Carr's index which is an expression of powder compressibility was calculated to be 23.05, a slightly poor value according to table ll.Amylose content, an implication of the fraction of polysaccharide in the matrix of the extracted starch was estimated to be 21.34%. Water binding capacity of 2.14% and gelatinization temperature (65o), a degree of cross-linking within the starch with no chemical alteration.Table lll explicitly shows the blending compositions of the sweet potato peel starch against the sucrose powder, both at 24mesh size. SPPS concentration was varied incrementally from 1% to 10% and powdered sucrose from 99% down to 90% with commercial confectionary sugar as a control. They were selectively subjected to pH, dissolved solids, electrical conductivity, tapped density, and bulk density determinations. Additionally with figure lll, it was revealed that blending B and C are similar in height with standard with respect to the five parameters studied. In other words, the blends were closely compared with the commercial anti-caking (cornstarch) blended confectionary sucrose powder. Fortunately, only blend B [pH= 7.0, TDS=47ppm, E.C= 0.047 uS/cm, T.D= 2.56g/ml & B.D=0.83g/ml] and C [pH= 6.8, TDS= 52ppm, E.C= 0.052uS/cm, TDS=2.70ppm, T.D=2.67g/ml & B.D=0.77] were observed to be in line with the control product [pH=6.7, TDS=53ppm, E.C=0.05uS/cm, T.D =2.67g/ml, B.D=0.77g/ml]

4.CONCLUSION

Organic and agricultural wastes in recent times have been technically utilized or applied as feedstock in renewable resources and technologies, such as animal feeds, biogas, biodiesel, bioethanol, pharmaceutical (drug excipient) and food product additives (anti-oxidants and anti-caking). Sweet potato peels starch has however demonstrated its potential in value addition with sucrose powder.
In the meantime, it is expected to evaluate the favorable and nondestructive chemical modifications that could improve the properties and performance of this resourceful extract in order to overcome those limitations reported in the course of this research so as to achieve an ideal product suitable for relevant applications
.

5.ACKNOWLEDGMENT

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6.CONFLICT OF INTEREST

There was absolutely no conflict of interest among the author.

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ology-toxicology-and-pharmaceutical-science/hausner-ratio

Blend	PPS (%)	S (%)	pH	TDS	E.C	B.D				
A	1	99								
B	2	98								
C	3	97								
D	4	96								
E	5	95								
F	6	94								
G	7	93								
H	8	92								
I	9	91								
J	10	90								