HER Vol. 28 No. 2, December 2021, pp. 96-110

Assessment of the Organoleptic Attributes of Fabrics Sized With Starch Extracted from Selected Local Food Substances

Ozougwu, S.U
Department of Home Science and Management,
University of Nigeria, Nsukka, Enugu State.

and

Ogbonnaya, O. B
Department of Home Economics,
Abia State College of Education (Tech),
Arochukwu, Abia State

Abstract

The study assessed the organoleptic attributes of fabrics sized with starch extracted from three selected food substances. Specifically the study: analyzed organoleptic attributes of three samples of fabrics sized with starch extracted from rice, corn and russet potatoes (local food substances). Study used experimental design. Starches samples were extracted following standard procedures. Size solution was prepared following Lata and Mehta (2012) method. Three different 20″x 20″ cotton fabric samples (100% plain white cotton, 100% coloured cotton and cotton blend (cotton/polyester 60/40%) were prepared. Following standard method, the fabric samples were sized, allowed to dry, and pressed for organoleptic evaluation. Data were collected in three phases using rating scales and analyzed using descriptive statistics. Three null hypotheses were tested with t-test at 0.05 level of significance. Results show that 100% coloured cotton organoleptic attributes were the most high of the rice sized samples, mean ranging from 3.32±0.57 to 4.08±0.79. All the corn sized 100% plain white and cotton blend sensory attributes were high top. Sweet potatoes sized coloured cotton was best in crispness (3.48±28), body (3.79±0.94), odour (3.34±0.68), sharp contour (3.75±0.95) and smoothness (3.19±0.76). There were no significant differences ($p>0.05$) in mean responses of panelists on the organoleptic attributes of all sized fabrics at 0.05 level of significance. It is recommended that rice, maize and russet potato starches should be explored for sustainability in 100% cotton and cotton/polyester blend fabric sizing.

Key words: Organoleptic, Acceptability, Cotton, Fabric, Sizing, Starch.

Introduction

The aesthetic or functional quality of any fabric and other textile products depend largely on the sizing and finishing treatment given either during or after production. In textile and clothing industries, sizing is a very vital process in which starch or other film forming polymer is applied to yarns before weaving as protecting filler, stiffener, or glaze to reduce abrasion, yarn breakage, machine stoppage and other stresses during weaving. Sizing strengthens and lubricates mostly the warp yarn during fabric production. In textile printing, sizing modifies the absorption capacity of those items thus acting as catalysts for oil-base surface platform for gilding in art works.

Sizing is also applied to parts or whole of limp fabrics and apparels during washings to improve their functional and aesthetic or organoleptic properties. The organoleptic attributes such as colour, texture or crispness, luster or gloss, body or hand of fabrics and garments could be restored through sizing (Marshal, Jackson, Stanley, Kefgen & Tochie–Specht, 2000). For any sizing agent or size to be acceptable in fabric or garment sizing, it must be colourless such that the aesthetic value of fabric would not be badly altered. Size should be smooth on sized fabric thereby improving the brightness and glossy or lustrous appearance of the sized fabric. It also improves the texture or feel and adds body to reinforce the weak or limp fabric. A sized fabric should have crisp texture and sharp contour effect. It should have neutral or pleasing odour. Any sized fabric with offensive odour is unacceptable to consumers. Sized fabrics shed soil easily because the dirt slides off the smooth finish as stains attach to the sizing agent making them easier to remove.

Different substances used as textile sizing agents or water soluble polymers include but not all; polyvinyl alcohol (PVA), carboxyl methyl cellulose (CMC), and starch (Altaf, Caroline, Frost, Gary & Robertson, 2006). Starch is a polysaccharide consisting of glucose units linked together to form long chains up to 500 to several 100,000 linked chains depending on the type of starch (BeMiler, 2009). It is a polymer of glucose consisting two type glucose polymers such as amylose and amylopectin (Li and Yeh, 2001) Starch is used in the manufacture of various adhesives for bookbinding, wall paper, paper sack, tube winding, gummed paper, envelopes, school glues and bottle labeling (Stryer, Lubert, Berg, Jeremy, Tymoczko and John, 2002) as well as for sizing for back filling of fabrics. This type of finish increases the stiffness and the capacity of the fabric by filling the interstices with the starch mixture.

Starch is the most common agent utilized in both yarn and fabric sizing. They are classified into inedible or modified and food, edible or native types. Laundry starch is a simple liquid that is used to provide a crisper appearance to various articles of clothing. Laundry starches are natural starches that have been changed in their physical and chemical properties. Surface sizing solution consists mainly of modified starches and sometimes other hydrocolloids such as gelatin, alkyl ketene dimer (AKD) or acrylic copolymers. Surface sizing agents are amphiphilic molecules having both hydrophilic and hydrophobic ends. The sizing agent adheres to the substrate or fibres and forms a film with the hydrophilic tail facing the fibre and the hydrophobic tail facing outwards resulting in a smooth finish that tends to be water-repellent. Native starches work best on natural fibres such as cotton and linen to provide crispness partly due to their similar chemical structure (Lata and Mehta, 2012). The composition of starch solutions used to finish fabrics and garments depend on fabrication and desired fabric properties. For stiffer texture, the starch concentration is increased.

Studies indicate that native starches produced from cereals such as millet, rice, wheat corn are rich in natural starches (Ashhobon, 2012). Ahmed, Peng, Na, Liu and Zhigang (2019), stressed that carbohydrate, mainly starch, is the major component of both the whole brown grain and refined white rice (73-76 and 77-78g/100g respectively) and is highly concentrated in the inner endosperm of rice kernel (Zhou, Robards, Helliwell, & Blanchard, 2002). Rice starch used in laundry work is usually prepared from broken white rice. Corn or maize starch is obtained from the endosperm of the corn karnel. It is a popular food ingredient used in thickening sauces or soups and in making corn syrup and other sugars. Starchy root vegetables including potatoes, yucca and cassava in form of powder or spray made from these are also rich in starch. Winter squashes such as pumpkin, butter nut also contain starches but in smaller quantities than grains and starchy vegetables (Aglaee, 2013). Potatoes store the food plant makes as complex carbohydrates (starch). The cells of root tubers of potato plant contain starch grains (Leucoplasts) and typical oval spherical granules; their size ranges between 5 and 100µm. Potato starch is a very refined starch containing minimal protein or fat. This gives the powder a clear white colour and the cooked starch typical characteristics of neutral taste, good clarity, high binding strength, long texture and a minimal tendency to foaming or yellowing of the solution. Potato starch contains approximately 800 parts per million (ppm) phosphate bound to the starch; this increases the viscosity and gives the solution a slightly anionic character, a low gelatinization temperature approximately 140^0 F (60^0 C). Pure starch is white, tasteless and odorless powder that is insoluble in cold water or alcohol.

Starch is a very important sizing agent in family clothing care and laundry. It is also important in teaching as raw consumable in educational institutions at all levels. The importance of starch in paper and printing as well as textile and clothing industries in Nigeria cannot be over emphasized. Unfortunately, there is presently scarcity of starch to meet these needs. Much utilized imported modified starches presently available locally are not in sustainable supply. They are synthetic, non biodegradable and thus human and eco unfriendly. Scarcity of starch for textile and clothing sizing for either during fabric production or garment finishing or renovation precipitated to closure of many of the clothing and textile industries in Nigeria (Onwualu, 2006). There is therefore need to explore the locally available sources from food substances. They are human and environmental friendly (Temesgen, Murugesan & Gideon, 2019), have low cost of production (Burrel, 2003), are cost effective (Temesgen, Endale, Beraga, Habte & Ahmed, 2019), and can be comparable to synthetic sizing agents (Kovacevic, Dimitrovski and Hadina, 2008). Large quantities of local rice termed rejects are wasted at site of processing. Corn and sweet potatoes also during period of bumper harvest were always great but most often wasted to food insecurity. Processing them into starches for future use is very imperative.

Various studies have been carried out on the effect of rice, corn, potato, cassava starches among others on the functional properties including tensile strength, abrasion resistance, thickness, end breakage, stiffness, weight of yarn during fabric construction have been conducted (Lata and Mehta 2012; Muhammed, Tahir, Shahid, Muhammed, & Bushra, 2014; Temesgen, Murugesan and Gideon, 2019). However, no studies have been documented on the oragnoleptic and aesthetic properties, as well as acceptability of the edible starches for fabric sizing and finishing during utilization. This is a gap which the present study seeks to focus on.

Objective of the study

The major objective of the study was to assess the organoleptic attributes of fabrics sized with starch extracted from selected local food substances. Specifically the study;

1. determined organoleptic attributes of three samples fabric (100% plain white, coloured and cotton blend) (cotton/polyester : 60/40%respectively) sized with starch extracted from rice, corn and russet potatoes local food substances.
2. determined the acceptability of 100% plain white, 100% coloured cotton and cotton blend fabrics sized with starch extracted from rice, corn and russet potatoes local food substances.

Hypotheses: Three null hypotheses were tested by the study:

HO_1: There are no significant differences ($p>0.05$) in mean responses of the panellists on organoleptic attributes of 100% plain white, coloured and cotton blend fabric samples sized with rice starch at 0.05 level of significance.

HO_2: There are no significant differences ($p>0.05$) in mean responses of the panellists on organoleptic attributes of 100% plain white, coloured and cotton blend fabric samples sized with corn starch at 0.05 level of significance.

HO_3: There are no significant differences ($p>0.05$) in mean responses of the panellists on organoleptic attributes of 100% plain white, coloured and cotton blend fabric samples sized with sweet potato starch at 0.05 level of significance.

Materials and Methods

Materials used for the study included broken rice grains, corn, russet potatoes. Three different fairly used cotton fabric samples used were 100% plain white cotton fabric, 100% coloured (dyed) cotton fabric and cotton blend (cotton/polyester 60:40 respectively). Sodium metabisulfite ($Na_2S_20_5$), 0.1M caustic soda (SO_2), 325 mesh screen,

The broken rice grains, corn and russet potatoes were all sourced from Ogige local market Nsukka. Fairly used 100% white medium weight cotton fabric, 100% orange coloured medium weight cotton fabric, cotton blend (cotton/polyester; 60/40% respectively) were accessed from the major distributor of fairly used fabrics and garment at Material Line Ogige market, Nsukka. The fibre percentages were identified through the care labels attached to the neckline or side seams.

Phases of the study: The study was carried out in the following phases:

Phase 1: Preparation of Samples/ Starch Extraction

Rice: Alkaline-steeping method About 1kg broken rice grains were steeped in distilled water in the ratio of 1:10 for about 72 hrs to soften the grain. About 0.1M caustic soda (SO_2) was added to set the pH and I% Sodium metabisulfite ($Na_2S_20_5$) to prevent microbial growth. After, the solution was washed away. The softened grains were wet milled with more water. The resulting mass or starch layer was agitated with water in the ratio 1:3 with additional 01M caustic soda solution. The peak lipid film was removed from the surface including protein. Un-bonded protein was separated with water. It was then filtered with 325 mesh screen and subjected to sedimentation over night. The excess water was decanted leaving the sediment (accumulated starch). It was then air-dried at room temperature for 48 hrs.

Corn: About 1kg of corn was weighed out. Corn kernel was hand-picked and cleaned to remove dirt particles and broken with grinder. The corn was steeped in 1.5litres distilled water and 1% sodium metabisulfite ($Na_2S_20_5$) solution was added to the steeped corn and allowed to stand for 72hr. After, the pericap was removed manually and the germ was separated from the endosperm. The endosperm was wet milled forming slurry then filtered using a 30-µpm nylon filter and washed three times with a litre of water. The filterate comprising starch-protein mixture was then subjected to sedimentation. The sediment (starch) was allowed to dry in open dry air for 48hr

Sweet Potato: About 1kg white russet potato was weighed out, peeled and ground into slurry with addition of water. To isolate the starch, the slurry was filtered using cheese filter cloth. The filtrate was allowed to settle overnight without shaking so that the mass of starch that accumulates will be recovered. The starch was then rinsed three times with water, water decanted and the sediment or starch mass dried under open dry air at room temperature.

Phase II: Fabric Sizing: This involved three different cotton fabric samples (100% plain white, 100% coloured cotton and cotton blend (cotton/polyester 60/40% respectively), each measuring 20″ by 20″ were cut out, washed with soap and water to remove dirt and finishes and dried on a line in open air.

Preparing the Size (Starch) Solution: The gel preparation was done using the best concentration as described in Lata and Mehta (2012) study. About 45g of rice starch was thoroughly dispersed and stirred in water to a smooth paste. The paste was poured in 1.5L of boiling water and stirred continuously until a transparent grey starch jelly was formed. The same process was used for corn and sweet potato jellies.

Fabric sizing: The rice jelly was later mixed properly with more 200ml of water to get the required concentration. The solution was divided into three equal parts and heated separately to 100^{0}C. Then, each of the cotton fabric samples: 100% plain white cotton,, 100% coloured cotton and cotton blend (cotton/polyester 60/40% respectively was immersed in the solution, stirred thoroughly to absorb the starch solution till the fabric got saturated with starch. The samples were taken out, pressed between palms to remove excess starch solution. The samples were then spread out on a line in open air to dry. The same process was repeated for the corn and sweet potato starches. After drying, all the 100% cotton samples were ironed with highest heat (204^{0}C or 400^{0}F) while cotton blend was ironed with moderate heat iron. The resultant prototype sized cotton and cotton blend samples were; labelled as follows: rice sized 100% plain white cotton fabric (RPC), rice sized 100% coloured cotton fabric (RCC), rice sized cotton plain white cotton blend (RCB), corn sized 100% plain white cotton fabric (CPC), corn sized 100% coloured cotton fabric (CCC), corn sized cotton plain white cotton blend (CCB), sweet potato sized 100% plain white cotton fabric (SPC), sweet potato sized coloured cotton fabric (SCC) and sweet potato sized cotton plain white cotton blend (SCB). All together, nine prototype sized samples were produced. An unsized sample that served as control was also pressed and displayed

Phase III: Organoleptic acceptability evaluation of the sized fabric samples

Selection of Panel of evaluators: Two categories of evaluators comprised 22 Lecturers and 18 Postgraduate students all together 40, from the Department of Home Science and Management of University of Nigeria, Nsukka . All evaluators have Home Economics background and were knowledgeable in the organoleptic and aesthetic attributes evaluation sought for.

Instrument for Data Collection: A validated 5-point rating scale was used to assess the acceptability of the quality of the sized fabric samples through visual inspection, feel, smell and rating the attributes. Attributes assessed in the scale included general appearance of starch on fabric, crispness imparted, odour, body, colour, contour and smoothness of sized fabrics using measurement variables and point ranges of: excellent (4.99-5.99), good (4.00-4.99), fairly good (3.00-3.99), poor (2.00-2.99) and extremely poor (<1-1.99)

Data Collection Method: Forty copies of the rating scale were distributed to the panelists to rate each sample piece displayed. Through visual inspection, feel and smell the panellists were asked to rate the aesthetic colour, texture/smoothness, contour, general appearance and smell (odour) of the sized and unsized fabric samples using the rating scale. The samples were labelled accordingly with short descriptions and keys to their meanings.

Data Analysis Technique: Data collected were analyzed using mean and standard deviation. All samples' attributes rated with mean scores <1.00-2.99 were regarded as poor or undesirable while those rated mean 3.00 and above were regarded as having desirable attributes and accepted by the panelists. The three null hypotheses were tested with t-test and accepted at 0.05 level of significance.

Results

Table 1: Mean Ratings and t-test Results Organoleptic Attributes of Three Samples of Fabric (100% Plain White, Coloured and Cotton Blend) Sized with Rice Starch.

Rice Sized Fabric	X_1 Sd_1	X_{II} Sd_{II}	X_{111} Sd_{111}	t-cal	P-value	Sig Level
100% plain white cotton						
General appearance	2.88±0.35	2.58±1.16	2.73±0.76	0.68	13.60	0.50
Texture/crispness	3.63±0.74	3.67±1.07	3.65±0.91	0.66	0.53	0.93
Body	3.50±0.76	3.75±0.87	3.63±0.82	-0.18	0.04	0.52
Odour	3.38±0.52	3.42±0.51	3.40±0.52	-0.18	0.13	0.86
Colour	1.88±1.13	1.83±0.94	1.86±1.04	0.09	0.43	0.93
Sharp contours	3.25±0.71	3.75±0.97	3.50±0.84	-1.25	0.35	0.23
Smoothness	2.75±1.04	3.17±1.11	2.96±1.08	-0.84	0.03	0.41
						0.63
100% plain coloured cotton						

Table 1 Contuned

General appearance	3.75±0.89	3.92±0.92	3.84±0.91	-0.41	0.00	0.69
Texture/crispness	3.63±0.74	4.08±1.16	3.86±0.95	-0.98	1.75	0.34
Body	3.18±1.04	4.08±1.00	3.63±1.02	-0.72	0.03	0.48
Odour	3.38±0.52	3.25±0.62	3.32±0.57	0.47	0,06	0.64
Colour	3.75±1.16	3.58±1.31	3.67±1.24	0.29	1.28	0.78
Sharp contours	3.88±0.83	4.08±0.79	3.98±0.81	-0.56	0.00	0.58
Smoothness	3.63±0.74	4.00±0.85	3.82±0.80	-1.01	0.23	0.33
						0.55
Plain white cotton blend						
General appearance	2.13±0.99	3.25±1.29	2.69±1.14	-2.09	1.87	0.05
Texture/crispness	3.00±1.20	3.421.24	3.21±2.44	-0.75	0.12	0.47
Body	3.25±0.89	3.42±0.79	3.34±0.84	0.44	0.02	0.67
Odour	3.13±0.64	3.33±0.49	3.32±0.57	-0.82	0.00	0.42
Colour	2.38±1.30	2.92±1.31	2.65±1.31	-0.91	0.01	0.28
Sharp contours	3.00±1.31	3.25±0.87	3.13±1.07	0.52	0.98	0.61
Smoothness	2.88±0.99	3.25±1.14	3.07±1.07	-0.76	1.58	0.46
						0.44

Key: XI Sdi - Mean and Standard deviation for Lecturers, XII SdII - Mean and Standard deviation for Postgraduate students, X111 Sd111 - Grand mean and Standard deviation for Lecturers and Postgraduate students, Df - Degree of freedom, t- cal- t- calculated, Sig - Significant level, ***(N=40, Df-38 XI =20, XII =20)***

Table 1 indicates that both categories of evaluators accepted four out of seven attributes of 100% cotton fabric sized with rice starch, with mean ranging from 3.40±0.52 to 3.65±0.91. The accepted attributes include stiffness (3.65±0.91), closely followed by weight (3.63±0.82). The most poorly and least accepted attribute was the colour of the sized fabric (1.86±1.04). For the rice sized 100% plain coloured cotton fabric, both categories of evaluators accepted all seven attributes since they were rated highly with mean ranging from 3.32±0.57 to 3.98±0.81. Minus general appearance (2.69±1.14) and colour (2.65±1.31) which were rated bellow acceptable mean, all other attributes of rice sized cotton blend were accepted.

HO$_1$: The t-test results on Table 1 with P-values of 0.63, 0.55 and 0.44 for the panelists on organoleptic attributes of rice starch on 100% plain white cotton, 100% plain colured and cotton blend fabrics respectively had P-values more than 0.05. These values indicate no significant differences supporting the null hypothesis stated that there are no significant differences. The null hypothesis is therefore accepted at P<.05 level of significance

Table 2: Mean Ratings and t-test Results on Organoleptic Attributes Three Fabric Samples (100% Plain White, Coloured and Cotton Blend) Sized with Corn Starch.

Corn Sized Fabric	X_1 Sd_1	X_{II} Sd_{II}	X_{111} Sd_{111}	t-cal	P-value	Sig Level
100% plain white cotton						
General appearance	400±0.93	4.00±0.74	4.00±0.84	0.00	0.00	1.00
Texture/crispness	3.75±0.89	3.50±0.67	3.63±0.78	0.72	0.05	0.48
Body	3.75±0.89	3.75±0.75	3.75±0.82	0.00	0.00	1.00
Odour	3.25±0.71	3.67±0.65	3.71±0.68	-1.36	0.00	0.19
Colour	3.13±1.36	3.83±0.94	3.48±1.15	-1.39	2.28	0.18
Sharp contours	3.75±0.46	3.75±1.06	3.75±0.76	0.00	1.45	1,00
Smoothness	3.75±0.89	3.67±0,98	3.48±0.76	0.19	0.80	0.85
						0.67
100% plain coloured cotton						
General appearance	4.13±0.35	3.83±0.83	3.98±0.59	0.93	2.82	0.37
Texture/crispness	2.75±0.25	2.67±0.65	2.71±0.45	0.24	1.66	0.81
Body	3.38±0.52	3.17±0.72	3.28±0.62	0.71	0.02	0.49
Odour	3.13±0.64	3.25±0.62	3.15±1.26	0.71	0.13	0.67
Colour	3.88±0.64	4.00±0.85	3.94±0.75	0.35	0.05	0.73
Sharp contours	3.25±0.46	3.17±1.11	3.21±0.79	0.20	3.18	0.85
Smoothness	4.00±0.54	3.83±0.98	3.92±0.78	0.45	3.93	0.66
						0.65
Plain white cotton blend						
General appearance	3.25±1.16	3.08±0.79	3.17±0.98	0.32	1.88	0.71
Texture/crispness	2.50±0.93	3.08±1.16	2.79±1.05	1.19	0.57	0.25
Body	3.25±1.04	3.17±0.72	3.21±0.88	0.26	1.36	0.83
Odour	3.13±0.64	3.33±0.65	3.23±0.65	-0.71	0.52	0.49
Colour	2.75±1.16	3.33±1.07	3.04±1.12	-1.15	0.23	0.27
Sharp contours	3.25±0.89	3.42±0.79	3.34±0.84	-0.44	0.29	0.67
Smoothness	3.25±1.04	3.75±0.75	3.50±0.90	-1.25	0.66	0.23
						0.49

Key: XI Sdi - Mean and Standard deviation for Lecturers, XII SdII - Mean and Standard deviation for Postgraduate students, X111 Sd111 - Grand mean and Standard deviation for Lecturers and Postgraduate students, Df - Degree of freedom, T- cal- T- calculated, Sig - Significant level, (N=40, Df-38 X_I =20, X_{II} =20)

Table 2 shows that all the seven attributes assessed of corn sized 100% plain white cotton fabric were accepted by both categories of evaluators with general appearance scoring highest (4.00±0.84). Aside from stiffness of 100% coloured cotton (2.71±0.45) and cotton blend (2.79±1.05), all other attributes were accepted. This was shown by the very high mean ratings ranging from 3.48±0.76 to 4.00±0.84 for 100% plain white cotton fabric, 3.21 ± 0.79 to 3.98± 0.59for 100% plain white cotton fabric and 3.04±1.12 to 3.50±0.90 for cotton blend.

HO_2: The t-test results on Table 2 with P-values of 0.67, 0.65 and 0.49 for both categories of evaluators on the organoleptic attributes of corn sized 100% plain white cotton, 100% plain colured and cotton blend fabrics respectively had P-values more than 0.05 indicating no significant differences in the mean responses of the respondents. The null hypothesis stating that there are no significant differences in the mean responses of the evaluators is therefore accepted at P<.05 level of significance.

Table 3: Mean Ratings and t-test Results on Organoleptic Attributes Three Samples of Fabric (100% Plain White, Coloured and cotton blend), Sized with Sweet Potato Starch.

Russet Potato Sized Fabric	X_I Sd_I	X_{II} Sd_{II}	X_{111} Sd_{111}	T	P-value	Sig Level
100% plain white cotton						
General appearance	1.00±0.53	2.17±1.40	1.59±0.97	-1.27	3.88	0.22
Texture/crispness	1.13±1.35	4.00±0.95	2.57±1.15	-1.70	3.03	0.10
Body	3.88±1.55	4.17±0.94	3.94±0.62	-0.53	3.22	0.01
Odour	1.38±1.06	2.92±1.16	2.96±0.85	0.19	7.29	0.85
Colour	1.38±1.06	1.58±1.00	1.48±1.03	-0.45	2.69	0.88
Sharp contours	3.00±1.41	3..08±1.08	3.64±1.25	-0.15	0.23	0.19
Smoothness	2.25±0.71	2.75±0.87	2,50±0.79	-3.36	0.16	0.66
						0.42
100% plain coloured cotton						
General appearance	2.50±0.93	3.17±0.83	2.84±0.88	-1.68	0.47	0.11
Texture/crispness	2.88±1.46	4.08±1.00	3.48±1.28	-2.21	1.64	0.04
Body	3.75±1.04	3.83±0.83	3.79±0.94	-0.20	0.29	0.85
Odour	3.25±0.46	3.42±0.90	3.34±0.68	-0.48	4.78	0.64
Colour	2.50±1.31	3.42±1.00	2.48±1.16	0.16	1.70	0.87
Sharp contours	3.63±1.06	3.83±0.83	3.73±0.95	-0.49	1.38	0.26
Smoothness	2.88±0.99	3,50±0.52	3.19±0.76	-1.85	0.89	0.08
						0.41
Plain white cotton blend						
General appearance	2.50±1.07	3.17±0.83	2.84±0.95	-1.57	0.75	0.14
Texture/crispness	2.63±1.60	3.25±0.83	2.98±1.22	-0.99	1.88	0.33
Body	3.50±1.07	3.83±0.83	3.67±0.95	-0.78	0.75	0.44
Odour	3.00±0.53	3.50±0.67	3.25±0.60	-1.76	3.97	0.10
Colour	1.75±0.89	2. 67±1.44	2.21±1.17	-1.61	3.3	0.13
Sharp contours	3.25±1.16	3.75±0.87	3.50±1.02	-1.10	2.17	0.29
Smoothness	2.50±1.07	3.42±1.00	2.96±1.04	-1.96	0.15	0.07
						0.21

Key: XI Sdi - Mean and Standard deviation for Lecturers, XII SdII - Mean and Standard deviation for Postgraduate students, X111 Sd111 - Grand mean and Standard deviation for

Lecturers and Postgraduate students, Df - Degree of freedom, T- cal- T- calculated, Sig - Significant level, N=40, Df-38 X_I =20, X_{II} =20).

Table 3 shows that only two of the seven attributes of sweet potato sized plain white cotton fabrics were accepted by the evaluators. They included body (3.94±0.62) and sharp contour (3.64±1.25). Contrary to the above, all attributes except general appearance (2.84±0.88) and colour (2.48±1.16) respectively were acceptable for the coloured cotton sample. For the sweet potato starch on cotton blend, the body (3.67±0.95), odour (3.25±0.60) and sharp contours (3.50±1.02) of the fabric samples were good and acceptable to the evaluators.

HO_3: The P-values of 0.42, 0.41 and 0.21 for rice, corn and sweet potato sized 100% plain white cotton, 100% plain coloured and cotton blend fabrics respectively had P-values more than 0.05. The values are more than 0.05 indicating the null hypothesis stating that there are no significant differences in the mean responses of lecturers and Post graduate students on the acceptability of the sized fabrics were accepted at P<.05 level of significance.

Discussion

The results show that most sized fabrics organoleptic aeathetic qualities were improved and accepted by the evaluators while some were unaccepted. Starch functionality is directly related to gelatinization and the properties of the paste which also affect the stability of products, consumer acceptance and production reliability (Šubarić, Ačkar, Babić, Sakač and Jozinović, 2012; Alczar-Alay and Meireles, 2015) For the rice sized fabric samples, the coloured 100% cotton samples' sensory attributes (general appearance, colour, crispness, body, odour, sharp contour and smoothness) were rated exceptionally highly and accepted. Miles in Hebeish, Rekaby, and Abd El-Rahman (2019) affirmed that when cotton fabrics are printed using vat dyes, dye is fixed in an alkaline medium in the presence of a strong reducing agent. The obtained prints are subjected to oxidation and solution compounds are converted to insoluble coloured derivatives. and higher amount of such starch in thickening produces high colour yield. This could explain why the colour and general appearance of rice sized coloured 100% cotton samples yielded better aesthetic results than plain white and cotton blends. The texture was crispy but pliable, smooth and lustrous. The limp fabric hand or body was reinforced, stronger and smoother. The finding by Lata and Mehta (2012) provided baseline data that may be responsible for these. Using different concentrations and temperatures on their study of impact of rice, corn, potato and sago starches on functional properties of cotton fabric, thickness of samples varied with increase in temperature and the variation was attributed to more absorption of the starch due to increased kinetic energy of the particles which resulted in thick film formation on the fabric sample. The solution in granular stage at 100^0 C gives maximum viscosity resulting in thick layer formation on the sample and as yarn diameters and fabric modulus increase, the stiffness of the fabric also increase. Researchers agree that there is direct relationship between warp diameter and fabric stiffness (Yuksekkay, Howard & Adanur, 2008), and that starch depend on relationship between amylase and amylopectin and other constituents found in starch granules including phosphates, lipids, phospholipids among others (Marinuthu, Chandrasekar, Murugan, Perumal & Marimuruthu, 2020)

Findings on corn sized samples revealed positive organoleptic attributes. Temesgen, Murugesan and Gideon (2019), tested the breaking strength, extension of break, work to rupture, strength, unevenness, hairiness, resistance to abrasion and size pick-up. Finding revealed that corn starch had relatively larger thickness and highest end breakage rate. Similarly, Lata and Mehta (2012) assessed fabric weight in grams per square meter (GSM), thickness, stiffness, tensile strength and wash fastness and discovered that corn starch gave more weight at lower temperature compared to the others as absorption of corn is more due to its waxy structure that does not retrograde easily. According to them, this is one of the reasons corn is used for commercial purposes. Kovacevic, Schwarz, Dordevic and Dordevic (2020) studied synthesis of corn starch derivatives and their application in yarn sizing that corn starch should be returned to sizing process for their economic, qualitative and ecological cost effectiveness only by synthesizing and grafting with appropriate initiators which significantly improve their properties. Though, for Temesgen et al, (2012), Ebinowen, Oloye and Daramola, (2018) corn sized yarns' performance was the poorest of other native starches (potato, cassava and yam) studied, results from the present study showed tremendous aesthetic attributes, specially of plain white 100% cotton and cotton blend samples. The colour and general appearance of plain white 100% cotton was rated excellent and highest. Colour value was lighter and chroma brighter without dirty parches. This partly indicates clarity of corn starch. The texture, hand, colour, smoothness and sharp contour were all accepted. Bhargava (1984), stressed that the degree of fabric stiffness is related to its fibre, yarn and fabric structure. Similarly, Afolayan, Omojola, Orijapogun et al (2012), affirmed that starch is effective for cotton sizing because the film has a natural ability to stretch before rupture to a degree that closely parallel the natural stretch of cotton.

With the exception of general appearance and colour, potato sized coloured 100% cotton fabric samples' organoleptic attributes were the most acceptable of all potato sized fabric samples as they were highly rated. The texture was crispy and pliable, smooth, not cracking (producing a chalky line) on flexing the material or folding it, and was odourless. The reason for better aesthetic and organoleptic properties of the coloured cotton fabric samples could be attributed to age long adsorption phenomenon better described by Langmuir equation (Arvind, Thaklar, William and George, 1970). Potato starch contains approximately 800 parts per million (ppm) phosphate bound to the starch which increases the viscosity and gives the solution a slightly anionic character which probably chemically cross-linked with the fabric dye thus improving the brightness of the sample. Potato also contains anthoxanthins pigments belonging to the flavones and flavonol families that contributed to the colour. The plain white and cotton blend samples lack crispy texture, developed cracks, chalky lines. Colour and general appearance ratings were rated from poor to extremely poor. Potato shows the least stiffness than when compared with cassava and corn and wheat but had h (Temesgen et al, 2019). Reports from various researchers indicate that potato starch functional and organoleptic properties could be enhanced by modification, grafting and addition of copolymers among others to achieve improved textile sizing (Djordjevic, Kovacevic & Djordvic, 2018; Fahmi, 2019.

Conclusion

The findings indicate that rice, corn and potato starches can be used as sizing on 100% plain white, coloured cotton and cotton blend (cotton/polyester: 60/40% respectively) fabrics. Though organoleptic aesthetic properties of these sized fabric samples differ, all starches extracted from rice, corn and potato improved more vividly the aesthetic properties of 100% coloured cotton samples. Corn sized plain 100% white cotton sample was also improved next to coloured cotton. This means they can be used as good sizing for revitalizing and renovating limp cotton fabric and cotton blends with appropriate procedures of extraction and application. There were no significant differences in the mean responses of both categories of evaluators on the acceptability of the rice, corn and potato sized fabrics at 0.05 probability level. Since F-values were greater than t-calculed in all instances. Null hypotheses were all accepted.

Recommendations

1. Rather than depend solely on imported synthetic starches that are more expensive, not easily available and which could pose human health and environmental hazards, natural starches from rice, corn and potatoes should be explored for the vast industrial productions and home or family utilizations for textile, clothing finishing and renovation and other uses.
2. Through entrepreneurial efforts, unemployed graduates, home makers and farmers could make fortunes by venturing into starch production and sale in commercial

quantities to textile and clothing and other allied industries.

3. Textile Chemists and scientists in textile and clothing industries should explore the local food substances for their industries since they have been found to be cost effective
4. Home Economics teachers at all levels of education should encourage their students through practical classes and projects to get oriented in the art of exploring the edible starches in both home use and for industrial future ese.
5. The Federal Government through the Raw Materials Research and Development Council (RMRDC), should encourage patenting of such research initiatives by provide bursary allowances to researchers.

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