Chemical and Physical Characteristics of Twenty One Sweet Potato Genotypes Collected from Malaysia

Karakteristik Kimia dan Fisik Dua Puluh Satu Genotip Ubijalar Asal Malaysia

Joko Susilo Utomo* and Erliana Ginting

Research Center for Food Technology and Processing
National Research and Innovation Agency
*E-mail: jokosut@gmail.com

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ABSTRACT

The chemical and physical characteristics of sweet potatoes are essential in terms of quality and preference of the products. Breeding of sweet potatoes has resulted in a large number of genotypes which generates variation in chemical composition and physical properties. Therefore, such characteristics of 17 sweet potato germplasm accessions and four commercial cultivars originated from Malaysia were evaluated to be able to select them for breeding and food purposes. The starch contents were significantly different ($p<0.05$) that ranged from 10.67 to 25.40% fresh weight basis (fwb). The purple-fleshed group showed a higher amylose content than those of the orange, white, and yellow-fleshed groups. A variation in sugar contents was also noted and the highest amount of fructose was observed in the yellow-fleshed group, followed by the orange, white, and purple-fleshed groups. However, glucose, sucrose, and maltose could not be grouped according to their tuber flesh colors. The textural properties of steamed tubers considerably varied between sweet potato genotypes. The white-fleshed sweet potato showed the lowest hardness value, followed by the orange, yellow and purple-fleshed genotypes. Moisture, starch, and amylose contents significantly correlated with hardness of the steamed tuber with r = -0.83**, 0.60**, and 0.61**, respectively, while adhesiveness was affected by moisture and amylose contents with r =0.54** and -0.37**, respectively. Springiness had a positive correlation with adhesiveness and chewiness exhibited a negative correlation with moisture content, however, it positively correlated with hardness. Sweet potatoes with low hardness and chewiness are suitable to be used as raw material for juice and jam, while those with medium hardness and chewiness are suitable for products made from mashed tubers. Sweet potatoes with firm texture are tailored for flour preparation, which can be further used for flour-based products. This study reflects a great variation in chemical and physical characteristics of sweet potato genotypes that can be further used for the breeding of improved varieties with desired criteria as well as suitability for particular food products.

Keywords: chemical, correlation, sweet potato, texture

ABSTRAK

Karakteristik kimia dan fisik ubijalar merupakan sifat penting yang menentukan kualitas dan tingkat penerimaan produknya. Kegiatan pemuliaan telah menghasilkan banyak varietas ubijalar yang bervariasi komposisi kimia dan sifat fisiknya. Oleh karena itu, dilakukan evaluasi karakteristik fisik dan kimia 21 genotipe ubijalar yang terdiri dari 17 aksesi plasma nutfah dan empat varietas komersial asal Malaysia yang selanjutnya dapat digunakan sebagai materi pemuliaan maupun bahan pangan. Kandungan pati pada 21 genotipe berbeda nyata ($p<0,05$) dan berkisar antara 10,67 sampai 25,40% basis basah (bb). Kelompok ubijalar yang daging umbinya berwarna ungu memiliki kandungan amilosa lebih tinggi dibandingkan dengan kelompok yang berwarna oranye, putih, dan kuning. Kandungan fruktosa tertinggi tampak pada kelompok ubijalar kuning, diikuti kelompok oranye, putih dan ungu. Namun, glukosa, sukrosa dan maltosa tidak dapat dikelompokkan menurut warna daging umbinya. Tekstur umbi kukus sangat bervariasi antargenotipe ubijalar. Ubijalar berdaging umbi putih menunjukkan tingkat kekerasan paling rendah, diikuti oleh genotipe berdaging umbi oranye, kuning dan ungu. Kadar air, pati dan amilosa berkorelasi nyata dengan kekerasan umbi kukus masing-masing dengan nilai r = -0,83**, 0,60**, dan 0,61**, sedangkan *adhesiveness* dipengaruhi oleh kadar air dan kadar amilosa dengan r =0,54** dan -0,37**. *Springiness* berkorelasi positif dengan *adhesiveness*, sedangkan *chewiness* berkorelasi negatif dengan kadar air namun berkorelasi positif dengan tingkat kekerasan. Ubijalar dengan tingkat kekerasan dan kekenyalan rendah sesuai digunakan sebagai bahan baku jus dan selai, sedangkan ubijalar dengan tingkat kekerasan dan kekenyalan sedang sesuai untuk produk yang terbuat dari pasta umbi. Ubijalar dengan tekstur yang keras sesuai untuk bahan baku tepung, yang selanjutnya dapat diolah menjadi produk berbasis tepung. Hasil penelitian ini menunjukkan bahwa karakteristik kimia dan fisik ubi jalar bervariasi antargenotipe. Genotipe-genotipe tersebut selanjutnya dapat digunakan sebagai tetua dalam perakitan varietas unggul untuk bahan pangan yang sesuai.

Kata kunci: kimia, korelasi, tekstur, ubijalar

INTRODUCTION

As a foodstuff, sweet potato is highly nutritious with a good source of energy, dietary fiber, vitamins and minerals (Sajeev *et al.* 2012, Lee and Lee 2016). Over 95% of global sweet potato is produced in developing countries (Ali *et al.* 2015), thus this crop is essential in terms of supporting the food security and combating malnutrition (Adu-Kwarteng *et al.* 2021). Therefore, development of sweet potato production was intensively performed through breeding to obtain high yielding cultivars with desired characteristics. This results in a large number of sweet potato cultivars with different physical properties (color, shape, and texture) and chemical composition, such as moisture, starch, amylose, natural pigments and bioactive components which ultimately would influence the quality and preference of both the intermediate and end products (Aina *et al.* 2012, Nafeesa *et al.* 2012, Ginting *et al.* 2015, Shaari *et al.* 2021).

Moisture as the major component (52–85%) in sweet potato tubers is an important factor affecting the physical and chemical characteristics of sweet potato products (Nwosisi *et al.* 2019). The moisture content is highly dictated by genetic or cultivar and environment factors (Shekar *et al.* 2015). Orange-fleshed sweet potato naturally tends to contain higher moisture relative to the white and purple-fleshed sweet potatoes (Ginting *et al.* 2015, Cartier *et al.* 2017). In addition, the moisture content normally changes during cooking that may vary from 1 to 4% and this considerably affects the texture properties of the steamed sweet potato tubers (Utomo and Rahman 2015, Eke-Ejiofor and Onyeso 2019, Utomo and Ginting 2021).

Other essential components are carbohydrate and starch, which makes up 80–90% and 30–70% of the total dry matter (Woolfe 1992, Zhu and Wang 2014). Differences in carbohydrate degradation during cooking due to varietal differences may lead to variation in textural properties (Sulaiman *et al.* 2020). During cooking (boiling, steaming, baking), the heat stable amylase enzymes (up to 70 ^{o}C) that endogenously exist in sweet potato tubers would hydrolyze starch into sugar and dextrin (Sajeev *et al.* 2012). The interaction of sugars or dextrin with pectic compounds in the cooked tubers would generate certain textural properties such as loss of firmness (Utomo and Rahman 2015, Adu-Kwarteng *et al.* 2021).

In addition, the pasting properties of sweet potato are also related to its chemical composition, particularly starch which may vary across cultivars (Sajeev *et al.* 2012). The gelatinization temperature of sweet potato starch may range from 60 to 90 °C (Allen *et al.* 2012, Sajeev *et al.* 2012). Other pasting properties, such as peak, final, and setback viscosity are also likely dictated by the physicochemical of sweet potato starch (Collado *et al.* 1999, Sajeev *et al.* 2012). These pasting properties can be used to predict the cooking quality of sweet potato cultivars (mealy and non-mealy) (Sajeev *et al.* 2012), which would influence the acceptance of the cooked products.

Sugar composition also plays an important role in determining the eating quality of sweet potato products. Although in general the term of sweet is considered as sweet by definition, there is a wide range in perceived sweetness levels of sweet potato cultivars, depending on the sugar profiles and degree of starch conversion into sugars during cooking. Sucrose, glucose, and fructose are the principal sugars present in fresh sweet potato tubers (Owusu-Mensah *et al.* 2016). In addition to such sugars, maltose and dextrin are respectively presence as a result of starch hydrolysis by alpha-amylase and beta-amylase during cooking (Owusu-Mensah *et al.* 2016). However, the degree of starch conversion into sugars may differ among cultivars due to differences in degree of amylose and amylopection polimerization as the main components of starch (Wei, *et al.* 2017), the activity of amylase enzymes, and cooking methods (Owusu-Mensah *et al.* 2016) that result in different sweetness levels. The sugar contents in fresh tubers exhibit interrelationships with individual sugar that can be used in screening the germplasm accessions for specific characteristics and uses. Sweet potato with high sweetness level after steaming or baking is desired for direct consumption purpose.

Sweet potato is commonly consumed as food snacks in Malaysia and highly appreciated for its sensorial quality, good source of energy, and nutrients (Shaari *et al.* 2021). In addition to local varieties, a number of improved varieties have been released in Malaysia (Zulkifli *et al.* 2021), reflecting that breeding of sweet potato and its development is of concerned. The availability of sweet potato germplasm accessions or collections with different traits is therefore essential regarding such activity. Characterization and evaluation of germplasm accessions have been conducted for morphology, yield, and organoleptic attributes (Thigayu *et al.* 2013) as well as phenotypic characters (Karim *et al.* 2022), however limited studies were noted for physicochemical properties. In the last few years, Malaysian Agriculture Research and Development Institute (MARDI), which has the responsibility to conserve agricultural crops also concerned on how to enhance the utilization of germplasm collections either for the breeder or the user (Nordin *et al.* 2015). The study on chemical composition and physical properties of sweet potato accessions in Malaysia has never been performed previously. Therefore, this study needs to be carried out in order to support the breeding in releasing the most suitable sweet potato varieties for high-quality food ingredients following the consumer preferences in Malaysia.

MATERIALS AND METHODS

Seventeen sweet potato accessions used in this study belonged to the University of Putra Malaysia (UPM) germplasm collection, which consisted of white, yellow, orange, and purple-fleshed sweet potato. In addition, four sweet potato cultivars were purchased at a local market. As there is no specific name of these commercial sweet potatoes, we named them according to their flesh color as *White*, *Yellow*, *Orange*, and *Purple* (Table 1).

The preparation was initiated by cutting the middle portion of each raw sweet potato tuber transversely to the long axis into 3.5 cm thick slab. Using a cork borer with 1.35 cm diameter (N, 10, Cork borer, Ambala, India), cylindrical samples were taken from each slab and trimmed into cylinders of 2.2 cm thickness. Samples were taken at the inner tissue of the tubers at an approximate distance of 1 cm from the tuber skin. The cylindrical samples were washed with tap water to remove adhered starch and steamed in a steamer (CPC 61, Rational, Germany) at 100°C and atmospheric pressure for 20 min. Cooked samples were kept in a closed container to avoid moisture losses and subjected to moisture content determination, uniaxial compression test and texture profile analysis (TPA) on the day of preparation.

Moisture content of fresh and cooked sweet potato tubers was determined using oven method (AOAC 1984). Approximately 5 g of samples were dried at 105°C overnight or until constant weight was attained.

Sweet potato flour was prepared by oven-drying the sliced fresh tubers at 55°C until the moisture content of about 6% and ground into flour. The flour was then packed, sealed tightly in a plastic bag and stored at -20°C for further analysis. Meanwhile, starch was prepared from fresh sweet potato tubers, which were peeled, cut, and ground using a Waring blender for 4 min at high speed with the addition of water (ratio of water to tuber = 4 : 1). The slurry was then filtered using a double layer of muslin cloth. This grinding and filtering process was repeated three times and the filtrate was settled for 2 h. The mucilaginous layer was removed and the sediment/starch was re-suspended with water. This sedimentation and washing activity were repeated three times. Wet starch was dried in a cabinet drier at 45 °C for 8 h, ground and sieved with a 100-mesh sieve.

Table 1. Seventeen accessions and four commercial cultivars of sweet potato

Accession/Cultivar	Flesh Colour	Planted in
10116	White	Serdang, Selangor
10168	White	Serdang, Selangor
10166	White	Serdang, Selangor
10217	White	Serdang, Selangor
11072	White	Serdang, Selangor
White	White	Bidor, Perak
0061	Yellow	Serdang, Selangor
10071	Yellow	Serdang, Selangor
10073	Yellow	Serdang, Selangor
10100	Yellow	Serdang, Selangor
10123	Yellow	Serdang, Selangor
10200	Yellow	Serdang, Selangor
Yellow	Yellow	Sepang, Selangor
10236	Orange	Serdang, Selangor
11085	Orange	Serdang, Selangor
11090	Orange	Serdang, Selangor
11092	Orange	Serdang, Selangor
Orange	Orange	Sepang, Selangor
10120	Purple	Serdang, Selangor
11214	Purple	Serdang, Selangor
Purple	Purple	Sepang, Selangor

Starch and amylose contents of sweet potato flour were expressed in fresh weight basis (fwb) and dry basis (db). Starch content was measured using acid-hydrolysis method and the subsequent sugars produced were determined using a Nelson-Somogyi method (AOAC 1984). Approximately 5 g of sweet potato flour was homogenized with 50 ml of 85% ethanol for about 1 h. Sediment was removed quantitatively by filtering the suspension using Whatman No 1 paper into erlenmeyer flask containing 200 ml of distilled water and 20 ml of 25% HCl. Hydrolysis was conducted by boiling the mixture for about 2.5 h. The solution was cooled, neutralized using 45% NaOH and made up into 500 ml. The solution was then filtered using a Whatman filter paper and the filtrate collected was measured using an analysis procedure for glucose determination (AOAC 1984). Starch content was calculated by multiplying the glucose content with a conversion factor of 0.9.

The apparent amylose content was determined using a colorimetric iodine binding procedure according to the method used by Juliano (1971). This method consists of two steps, viz. preparing the standard curve of amylose (Merck) using different concentrations and determination of amylose content in the sweet potato starch. The standard curve was created by plotting the absorbance versus amylose concentration.

Amylose content was determined through mixing 100 mg of sweet potato flour with 1 ml of 95% ethanol and 9 ml of 1 N NaOH, heated in boiling water for 10 min, cooled and made up to 100 ml. About 5 ml of the sample solution was filled into a volumetric flask, added with 1 ml of 1 N Acetic acid and 2 ml of Iodine solution, stirred well then measured the absorbance at 625 nm wavelength using a spectrophotometer (Genesys 10uv, Thermo Scientific). The results were plotted into the standard curve to calculate the content of amylose in the samples.

Individual sugar of glucose, fructose, maltose, and sucrose existing in fresh sweet potato tuber was determined using HPLC method as described by Picha (1985) and Rees *et al.* (2003). A Waters liquid chromatography unit (Waters Co., Milford, Massachusetts, USA) was equipped with a Waters 410 RI detector, a Waters 501 injector and Pump and a Waters 600 controller. The sugars were separated using a Lichrosper® 100 NH_2 column (10 μm; 250 x 4.6 mm i.d., Merck). The isocratic elution of acetonitrile and water (80 : 20, v/v) was applied with a flow rate of 1.0 mL/min and the analyte was detected using RI detector.

About 1 g of sweet potato flour was heated with 100 ml of 85% methanol on a steam bath for 30 min. The mixture was filtered through Whatman No. 1 paper into round bottom flask and re-extracted the residue twice with 75 ml of methanol. The filtrate was then evaporated to about 10 ml using a vacuum rotary evaporator at 50 °C and made up the volume to 10 ml in a volumetric flask. About 2.5 ml of the extract was passed through a cation-ion exchange (Sep Pak C_{18}) cartridge and gently eluted 1.25 ml to the waste, while the rest was collected for analysis. Finally, the extract was filtered through a 0.45 μm membrane filter (Whatman) using a syringe. Ten micro liters (μL) of the sample extract was injected into the HPLC unit. Individual sugar in the samples was identified and quantified through the retention time and comparing the peak areas of samples with respective sugar standards. The mixed standard containing fructose, glucose, maltose, and sucrose was prepared by dissolving each standard in the mobile phase of acetonitrile and water with the proportion of 80 : 20 (v/v). The concentration of each sugar standard was 1% (w/v).

Peak force deformation was measured using uniaxial compression on cylinder of cooked tissue adopted from Walter *et al.* (2000). Uniaxial compression test was performed using a Texture Analyzer (TA.TX2i, Godalming, UK) fitted with a 25 kg load cell with a probe having 50 mm diameter compression plate. The compression was along the longitudinal axis of the steamed cylindrical specimen to about 75% of its initial height at a constant crosshead speed of 1 mm/s. The data was collected from the graph generated during the test. The peak force-deformation curves were obtained from 15 replicates per sample.

Hardness, adhesiveness, springiness, and chewiness were measured using Texture Profile Analysis (TPA) method as described by Nishinari *et al.* (2013). Texture Analyzer (TA.TX2i, Godalming, UK) was fitted with a 25 kg load cell with a probe having 50 mm diameter compression plate. The steamed cylindrical specimen was compressed longitudinal for two cycles. The test condition was: pre-test speed 2 mm/s, test speed 1 mm/s, post test speed 2 mm/s, time between two cycles 5 second and degree of compression 35% of its initial height. The TPA curves were obtained from 15 replicates per sample. Data collection and analysis were accomplished by the EXTRAD Dimension Software that is supplied together with the Texture Analyzer.

The experiment was arranged in a randomized complete block design with three replications. The data were statistically evaluated by analysis of variance (ANOVA) using a MSTAT-C software. Duncan's multiple range test (DMRT) was subsequently employed to see differences among sweet potato cultivars with a significant level of 0.05.

RESULTS AND DISCUSSION

Moisture content

Table 2 shows that the moisture content of fresh tubers ranged from 62.94 to 80.29% with the average of 74.56 %. The mean of each group was 76.27, 76.26, 74.23, and 67.70% for white, yellow, orange, and purple-fleshed sweet potato, respectively. Within the white-fleshed group, three accessions had higher moisture contents than the mean value, while the other two accessions and *White* cultivar were lower. The mean value of yellow-fleshed group was similar to that of the white-fleshed group, however the variation was larger with the highest value of 80.29% and the lowest was 72.16%. *Yellow* cultivar exhibited the highest moisture content compared to three other commercial cultivars. Conversely, small variation was noted for the orange-

Table 2. Moisture content of fresh and steamed tuber from 17 accessions and four commercial cultivars of sweet potato

Accession/Cultivar	Flesh colour	Moisture of fresh tuber (% fwb)	Moisture of steamed tuber (% fwb)
10116	White	78.69±0.17 [b]	81.33±0.23 [a]
10168	White	79.67±0.37 [a]	81.08±0.10 [ab]
10166	White	73.18±0.91 [i]	72.46±0.64 [j]
10217	White	75.26±0.61[ef]	79.31±0.27[c]
11072	White	76.59±0.09 [de]	75.68±0.01[ef]
White	White	73.82±0.45 [hi]	75.96±0.40 [e]
10061	Yellow	80.29±0.28 [a]	80.54±0.78 [abc]
10071	Yellow	77.93±0.51 [bc]	79.77±0.42 [bc]
10073	Yellow	73.62±0.21 [hi]	72.80±0.24 [ij]
10100	Yellow	72.16±0.18 [j]	70.47±0.97 [k]
10123	Yellow	77.15±0.06 [cd]	79.62±0.66 [bc]
10200	Yellow	74.16±0.37 [hi]	75.73±0.30 [ef]
Yellow	Yellow	78.53±0.14 [b]	80.54±0.57 [abc]
10236	Orange	70.80±0.02 [k]	74.05±0.81 [ghi]
11085	Orange	75.32±0.13 [fg]	73.73±0.18 [hij]
11090	Orange	73.89±0.46 [hi]	74.31±0.09 [fgh]
11092	Orange	74.67±0.38 [gh]	74.47±0.34 [efgh]
Orange	Orange	76.48±0.35 [de]	75.44±0.56 [efg]
10120	Purple	62.94±0.78 [l]	65.12±1.26 [l]
11214	Purple	63.39±0.92 [l]	63.53±0.13 [m]
Purple	Purple	76.78±0.48 [d]	77.78±1.61 [d]
Mean ± std dev		74.56±4.52	75.41±4.85

Means within a column followed by different superscript letters are significantly different at $p<0.05$.

fleshed group compared to other flesh color groups. However, a significant different ($p<0.05$) was found within the member of this group. Meanwhile, high variation of moisture content was observed in the purple-fleshed group associated with a relatively high moisture seen in the *Purple* cultivar (76.78%) compared to two other UPM accessions.

The variation of moisture content does not depend only on the accession or cultivar/genetic factor, but also environmental factors, such as location, climate/season, day length, soil type, pest and disease attacks, and cultivation practices (Ali *et al.* 2012, Laurie *et al.* 2012, Shekar et al 2015). Four commercial cultivars were cultivated in different areas. *White* was cultivated by farmer in sandy soil of Bidor, Perak, Malaysia, whereas the three other cultivars were planted in peat soil of Sepang, Selangor, Malaysia. Meanwhile, the 17 germplasm accessions were grown in Serdang, Selangor Malaysia. In addition, fertilizer application also affected the moisture content of the tubers as it normally decreases with the increasing amounts of nitrogen (Relente and Asio, 2020).

The changes of moisture content occurred after sweet potato tubers were steamed at 100°C for 20 min. A positive correlation was found between the moisture content of fresh tubers and steamed tubers ($r = 0.94$, $p<0.01$) (Table 6). The increase in moisture content was observed in 11 accessions and three commercial cultivars, which varied from 1-4%. It does seem that the intercellular spaces were filled by moisture during steaming. Meanwhile, six accessions showed a decrease in moisture content after 20-min steaming varying from 0.45 to 1.7%. This phenomenon of increase and decrease in moisture content during steaming was also reported by Utomo and Ginting (2021) in white and yellow-fleshed sweet potato as well as by Eke-Ejiofor and Onyeso (2019) due to absorption of external water and evaporation (Utomo and Ginting 2021). Sweet potato with higher dry matter or amylose content tends to absorb more water for undergoing the gelatinization process and the absorption is quitted if the cellular water is sufficient (Li *et al.* 2013).

Starch and amylose contents

The carbohydrates in sweet potato tubers play an important part not only in the degree of sweetness of the cooked tubers, but also in their texture. Starch is the major component of carbohydrates, which may comprise 30 to 70% of sweet potato dry matter (Woolfe, 1992). The starch contents of 17 accessions and four cultivars varied widely, particularly for the white and purple-fleshed groups (Table 3). The starch

Table 3. Starch and amylose content of 17 accessions and four sweet potato cultivars

Accession/Cultivar	Flesh colour	Starch (% fwb)	Starch (% db)	Amylose (% db)
10116	White	11.02 ± 0.84[hij]	53.47 ± 0.02[b]	23.95 ± 0.13[bc]
10168	White	10.67 ± 0.13[ij]	52.98 ± 0.04[fgh]	23.76 ±0.09 [bc]
10166	White	16.59 ± 1.01[d]	52.93 ± 0.03[ghi]	25.61 ± 1.39[abc]
10217	White	14.86 ± 0.21[de]	53.75 ± 0.01[a]	24.64 ± 1.40[abc]
11072	White	13.53 ± 0.05[efg]	53.53 ± 0.05[b]	24.96 ± 1.38[abc]
White	White	19.30 ± 0.57 [c]	53.21 ± 0.02[de]	25.53 ± 1.55[abc]
10061	Yellow	9.87 ± 0.13 [j]	53.71 ± 0.01 [a]	23.11 ± 0.09[c]
10071	Yellow	11.72 ± 1.07[ghij]	53.52 ± 0.05[b]	19.15 ± 3.73[d]
10073	Yellow	15.51 ± 0.09[de]	52.90 ± 0.00[hi]	24.67 ± 0.09[abc]
10100	Yellow	15.08 ± 2.17[de]	52.98 ± 0.01[fgh]	25.06 ± 0.53[abc]
10123	Yellow	13.27 ± 0.05[efgh]	53.05 ± 0.14[f]	23.57 ± 0.15[bc]
10200	Yellow	14.16 ± 0.55[def]	52.85 ± 0.02[ij]	24.67 ± 0.23[abc]
Yellow	Yellow	12.34 ± 1.01[fghi]	53.37 ± 0.02[c]	24.83 ± 0.94[abc]
10236	Orange	16.23 ± 0.66[d]	52.95 ± 0.11[fghi]	27.93 ± 5.71[ab]
11085	Orange	11.51 ± 0.80[ghij]	53.29 ± 0.02[cd]	26.52 ± 1.20[abc]
11090	Orange	15.01 ± 0.16[de]	53.22 ± 0.05[de]	26.35 ± 0.88[abc]
11092	Orange	14.34 ± 0.05[def]	53.51 ± 0.24[b]	26.33 ± 1.15[abc]
Orange	Orange	14.43 ± 1.40[def]	53.01 ± 0.01[fg]	27.15 ± 1.59[abc]
10120	Purple	22.53 ± 1.94[b]	52.79 ± 0.04[j]	26.94 ± 0.50[abc]
11214	Purple	25.40 ± 1.61[a]	53.15 ± 0.07[e]	26.69 ± 1.38[abc]
Purple	Purple	14.47 ± 1.23[def]	53.03 ± 0.04[fg]	28.79 ± 4.05[a]
Mean±std. dev		14.85 ± 3.77	53.20 ± 0.29	25.25 ± 2.03

Means within a column followed by different superscript letters are significantly different at $p<0.05$

content was presented in fresh weight basis (fwb) and dry basis (db), respectively to show its real amount in fresh tuber condition and to compare the amount between accesion/cultivar without any moisture in dry tuber as the content of moisture considerably varies in the tubers. The starch content of 17 accessions and four commercial cultivars in this study varied from 9.87 - 25.40% (fwb) or 52.79 - 53.75% (dw). These results were in agreement with the values reported by Sato *et al.* (2018) for cream, yellow, and orange-fleshed sweet potatoes that ranged from 6.02 - 23.40% (fwb). Similarly, Yooen *et al.* (2018) obtained a starch content ranging from 8.78% to 20.05% (fwb) for different flesh colors of Korean cultivars. A range value of 50.3 - 66.6% (db) was also noted by Ginting *et al.* (2015) for 12 purple-fleshed sweet potato genotypes. This suggests a high variation in moisture content of the fresh tubers as the starch contents in dry basis are relatively similar.

Amylose as a linear component of starch greatly affects the functional properties of starch, such as water absorption capacity during heating, swelling power, solubility, pasting and gelatinization temperature, and viscosity (Dereje *et al.* 2020, Wang *et al.* 2020). The amylose content showed a considerable variation among sweet potato accessions and cultivars that ranged from 19.15% to 28.79% (db) as listed in Table 3. On average, the purple-fleshed group contained the highest amylose (27.48% db), followed by orange (26.86%), white (24.74%), and yellow-fleshed group (23.58%). Four commercial cultivars differing in flesh colors likely showed a similar pattern of amylose content with those of 17 accessions. The amylose contents obtained in this study were within the range values reported by other studies, *c.a.* 23.3-26.5% (Lai *et al.* 2016), 20.8-25.2% (db) in purple-fleshed sweet potato genotypes (Ginting *et al.* 2015) and 19.5-24.6% (db) in nine cultivars with white, yellow, and purple flesh colors (Guo *et al.* 2019). Guo *et al.* (2019) also revealed that the flesh color was likely have no relationship with the physico-chemical properties of starch as it is more related with the genetic factor or cultivar. Similarly, the variation of amylose content in sweet potato starch was found to be affected by cultivar as well as growth environment conditions to a limited range (Lai *et al.* 2016).

Sugar contents

Figure 1 illustrates a chromatogram of sugar profiles in fresh sweet potato tubers. The peak of fructose initially appeared, followed by glucose, sucrose, and maltose, respectively. Sucrose, glucose and fructose are the principal sugars present in fresh

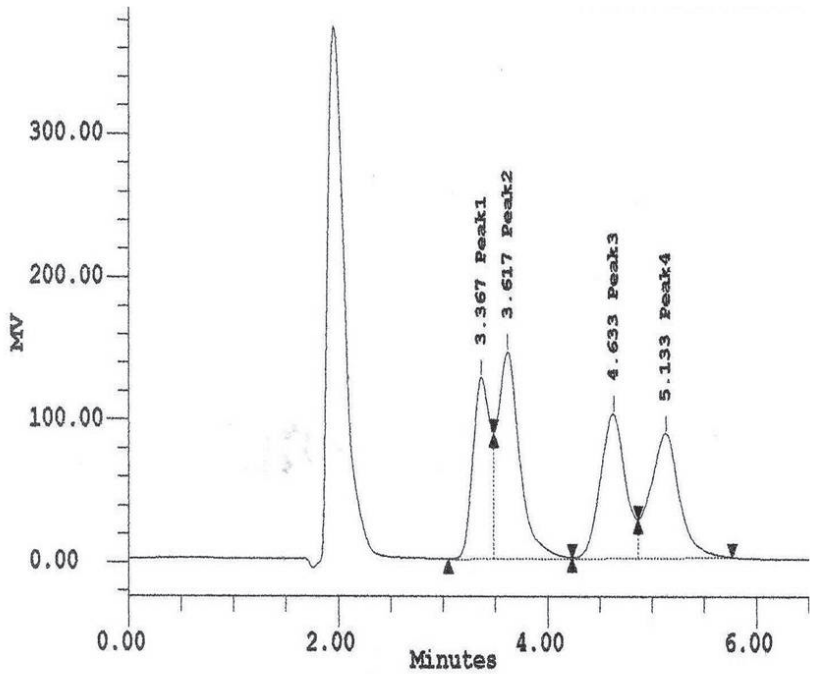

Fig. 1. Chromatogram of the major sugars existing in fresh sweet potato tubers. Peak 1=fructose, Peak 2=glucose, Peak 3=sucrose, Peak 4=maltose. MV = milivolt

sweet potato (Owusu-Mensah *et al.* 2016, Wei *et al.* 2017). However, the profile and concentration may change during processing, particularly heat treatment, and would influence the eating quality and preferences of the products (Wei *et al.* 2017).

The amount of individual sugar in fresh tubers of 17 accessions and four commercial cultivars is shown in Table 4. Sucrose was the most abundant sugar, followed by glucose, fructose, and maltose. Glucose was the second major sugar in 14 out of 17 accessions with the content varied from 1.1 - 2.37% (db), and one accession (11214) having less than 1%. The white-fleshed group contained the highest glucose, followed by yellow, orange, and purple-fleshed group. Meanwhile, four commercial cultivars contained much lower glucose that varied from 0.07 to 0.89 % (db). The higher contents of glucose relative to fructose in this study was in agreement with the results obtained by Lai *et al.* (2013) in seven sweet potato varieties grown in Taiwan, while relatively similar of both values were noted by Agnes *et al.* (2012).

Fructose was present in a lower content than glucose which varied from 0.05 to 1.87% (Table 4). The average of fructose content was 1.09, 1.47, 1.06, and 0.75% for white, yellow, orange, and purple-fleshed group, respectively, with the mean of 1.16%. In general, insignificant difference was found in fructose content among the members of white, yellow and orange-flesh colour groups of 17 accessions, while it was significantly different for purple-fleshed group. Four commercial cultivars showed a significant difference in fructose content compared to their respective flesh color in the germplasm accessions (<0.05) due to much lower value that ranged from 0.05% to 0.8%.

Sucrose was the predominant sugar in fresh sweet potato tubers. Lai *et al.* (2013) noted that sucrose constitutes about 50-92% of the total sugar. In this study, sucrose also showed the highest amount compared to other sugars, particularly for the orange and purple-fleshed accessions, including four commercial cultivars. The sucrose content varied from 1.22 to 3.79% (db) as seen in Table 4. On average, the sucrose content was 1.91, 1.71, 2.95 and 2.60% (db) for white, yellow, orange, and purple-fleshed group, respectively. The white and yellow-fleshed groups showed similar sucrose contents, while it was significantly different for the orange and purple-fleshed groups as the latter had higher amounts of sucrose. The orange accession of 10236 contained the highest sucrose (3.79%), followed by the purple accession of 11214 with a value of 3.34%. Among four commercial cultivars, *Orange, Yellow,* and *Purple* showed the higher content of sucrose (2.41-2.92%), while the lowest value was obtained in *White* (1.70%). These values of sucrose were relatively lower than those reported by Agnes *et al.* (2012) in 10 sweet potato varieties grown in Uganda *c.a.* 5.79-14.42% db.

In contrast, maltose generally exists in a very low amount in fresh sweet potato tubers and considerably present in the cooked tubers (Lai *et al.* 2013, Owusu-Mensah *et al.* 2016). A wide variation of maltose content was noted in 17 accessions and four commercial cultivars, ranging from 0% to 1.53% (Table 4). The mean values of the four groups were as follow: white 0.77%, yellow 1.13%, orange 0.95%, and purple 0.74%, whereas an overall mean was 0.93 %. All the 17 accessions and two cultivars (*Orange* and *Yellow*) had relatively similar maltose contents, while it was different for *White* and *Orange* cultivars as the presence of maltose was not detected. Lai et al (2013) reported relatively similar amounts of glucose (1.17% db) and maltose (0.13% db) in seven sweet potato varieties with the values obtained in this study, however the fructose content was lower (0.60% db) and the sucrose amount was higher (4.43%). CYY95-26 variety in the latter study particularly gave a considerable amount of sucrose (7.77% db). Differences in sugar profiles and amounts are considerably related to cultivar as well as amylase activity and growing enviroment conditions (Agnes *et al.* 2012).

Textural characteristics

Table 5 shows the textural characteristics of 17 accessions and four cultivars. A wide variation of textural properties between sweet potato genotypes was noted. In general, the peak force deformation values of 17 accessions were higher than those of *White, Orange,* and *Purple,* except for *Yellow* which showed higher value than three other commercial cultivars. The highest value was seen in the purple accession of 10120, followed by 11214 (purple) and 10116 (white), suggesting a firm characteristic of the steamed tubers of such accessions. Meanwhile, the orange and yellow groups gave relatively lower values. Utomo and Ginting (2021) also noted that the white-fleshed cultivar showed a higher value of peak deformation than that of the yellow-fleshed cultivar. Texture determination using both methods of TPA and peak deformation exhibited similar results of hardness and peak force, giving a positive correlation with r = 0.90 (p<0.01) (Table 6). A similar finding (r = 0.92) was also observed by Utomo and Ginting (2021) for white and yellow-fleshed cultivars. This reflects that both methods were suitable for hardness determination of steamed sweet potato samples, even though different settings of instruments were applied during testing.

Moisture content was an important factor affecting peak force deformation and hardness, which showed a negative correlation (p<0.01) as presented in Table 6. Yellow-fleshed cultivar which contained higher moisture gave a higher value of peak force

Table 4. Sugar content of fresh sweet potato tubers from 17 accessions and four cultivars

Cultivar	Flesh colour	Glucose (% db)	Fructose (% db)	Sucrose (% db)	Maltose (% db)
10116	White	1.59 ± 0.27^{bcdef}	1.40 ± 0.06^{abcd}	1.80 ± 0.40^{fg}	0.88 ± 0.24^{abcd}
10168	White	1.90 ± 0.16^{abcd}	1.54 ± 0.39^{abc}	2.55 ± 0.10^{cdef}	0.58 ± 0.03^{cde}
10166	White	1.73 ± 0.86^{abcde}	0.89 ± 0.55^{defg}	1.79 ± 0.88^{fg}	1.23 ± 0.72^{abc}
10217	White	1.99 ±0.04^{abc}	1.07 ± 0.19^{cdef}	1.72 ± 0.00^{fg}	0.73 ± 0.01^{bcd}
11072	White	2.37 ± 0.09^{a}	1.22 ± 0.21^{bcdef}	1.94 ± 0.01^{efg}	1.20 ± 0.09^{abc}
White	White	0.63 ± 0.25^{hij}	0.45 ± 0.19^{ghi}	1.70 ± 0.26^{fg}	0.00 ^{e}
10061	Yellow	1.42 ± 013^{cdefg}	1.61 ± 0.03^{abc}	1.22 ± 0.17^{g}	0.80 ± 0.02^{abcd}
10071	Yellow	1.53 ± 0.37^{cdefg}	1.35 ± 0.40^{abcd}	1.29 ± 0.23^{g}	0.92 ± 0.21^{abcd}
10073	Yellow	1.10 ± 0.72^{efgh}	1.53 ± 0.09^{abc}	1.24 ± 0.28^{g}	1.39 ± 0.00^{ab}
10100	Yellow	2.34 ± 0.19^{a}	1.77 ± 0.39^{ab}	2.09 ± 0.09^{defg}	1.51 ± 0.02^{a}
10123	Yellow	2.28 ± 0.30^{ab}	1.87 ± 0.55^{a}	1.45 ± 0.15^{g}	1.41 ± 0.21^{ab}
10200	Yellow	1.39 ± 0.12^{cdefg}	1.41 ± 0.43^{abcd}	1.87 ± 0.15^{efg}	1.52 ± 0.20^{a}
Yellow	Yellow	0.89 ± 0.19^{fghi}	0.80 ± 0.19^{efg}	2.84 ± 0.06^{bcd}	0.91 ± 0.04^{abcd}
10236	Orange	1.44 ± 0.05^{cdefg}	1.29 ± 0.30^{bcde}	3.79 ± 0.01^{a}	1.40 ± 0.03^{ab}
11085	Orange	1.51 ± 0.05^{cdefg}	1.36 ± 0.25^{abcd}	3.49 ± 0.08^{ab}	1.31 ± 0.09^{abc}
11090	Orange	1.19 ± 0.53^{defgh}	1.16 ± 0.60^{cdef}	2.73 ± 0.92^{bcde}	0.94 ± 0.45^{abcd}
11092	Orange	1.33 ± 0.38^{cdefg}	1.20 ± 0.13^{cdef}	1.82 ± 0.51^{fg}	1.13 ± 0.27^{abc}
Orange	Orange	0.35 ± 0.02^{ij}	0.27 ± 0.01^{hi}	2.92 ± 0.27^{bcd}	0.00 ^{e}
10120	Purple	1.63 ± 0.36^{bcde}	1.50 ± 0.56^{abc}	2.06 ± 0.44^{defg}	0.72 ± 0.33^{bcd}
11214	Purple	0.82 ± 0.01^{ghi}	0.70 ± 0.14^{fgh}	3.34 ± 0.48^{abc}	0.42 ± 0.60^{de}
Purple	Purple	0.07 ± 0.10^{j}	0.05 ± 0.07^{i}	2.41 ± 0.00^{def}	1.07 ± 0.02^{abcd}
Mean±std dev		1.40 ± 0.62	1.16 ± 0.48	2.19 ± 0.75	0.93 ± 0.43

Means within a column followed by different superscript letters are significantly different at p<0.05

Table 5. Textural characteristics of 17 accessions and four sweet potato cultivars

Accession/ Cultivar	Flesh colour	Peak force deformation (N)	TPA Hardness (N)	Adhesive-ness (Ns)	Cohesive-ness (Ns)^{ns}	Springi-ness (%)	Chewi-ness (N)
10116	White	13.51 ±1.52^{bc}	9.80 ± 2.20^{c}	0.17 ± 0.03^{abc}	0.54 ±0.01	79.75 ± 2.94^{def}	426.12 ± 1.27^{b}
10168	White	7.80 ±0.29^{efg}	7.75 ± 0.03^{de}	0.11 ± 0.02^{cdefg}	0.53 ±0.02	76.08 ± 1.63^{f}	316.84 ± 0.01^{cd}
10166	White	6.98 ±0.64^{fgh}	6.76 ± 0.54^{ef}	0.07 ± 0.02^{g}	0.42 ±0.00	83.19 ± 1.39^{cdef}	236.56 ± 0.27^{defg}
10217	White	6.55 ±0.75^{gh}	4.52 ± 0.03^{hi}	0.17 ± 0.03^{abc}	0.44 ±0.01	85.96 ± 3.03^{abcde}	170.00 ± 0.06^{g}
11072	White	6.53 ±0.12^{gh}	6.20 ± 1.04^{efg}	0.15 ± 0.03^{bcdef}	0.49 ±0.01	82.86 ± 3.02^{cdef}	253.38 ± 0.59^{defg}
White	White	5.59 ±0.77^{h}	6.73 ± 0.29^{ef}	0.24 ± 0.07^{a}	0.44 ±0.01	92.57 ± 6.38^{a}	273.07 ± 0.01^{def}
10061	Yellow	5.56 ±0.46^{h}	5.74 ± 0.07^{fgh}	0.15 ± 0.02^{bcde}	0.50 ±0.01	79.74 ± 4.43^{def}	231.66 ± 0.11^{defg}
10071	Yellow	8.78 ±0.15^{e}	6.94 ± 0.17^{ef}	0.16 ± 0.01^{bcd}	0.52 ±0.02	79.53 ± 0.28^{def}	288.91 ± 0.10^{cde}
10073	Yellow	10.82 ±1.14^{d}	12.11 ± 0.51^{b}	0.12 ± 0.02^{cdefg}	0.52 ±0.01	81.80 ± 0.98^{cdef}	517.50 ± 0.23^{a}
10100	Yellow	12.28 ±1.55^{c}	13.23 ± 0.53^{ab}	0.15 ± 0.02^{bcde}	0.52 ±0.00	81.42 ± 0.02^{def}	564.94 ± 0.21^{a}
10123	Yellow	6.20 ±0.57^{gh}	5.76 ± 0.08^{fgh}	0.22 ± 0.01^{ab}	0.52 ±0.01	81.59 ± 5.42^{def}	242.96 ± 0.12^{defg}
10200	Yellow	6.68 ±0.53^{fgh}	6.79 ± 1.22^{ef}	0.09 ± 0.02^{defg}	0.47 ±0.00	79.27 ± 4.20^{def}	258.13 ± 0.60^{defg}
Yellow	Yellow	10.24 ±0.06^{d}	4.94 ± 0.44^{ghi}	0.21 ± 0.01^{ab}	0.46 ±0.01	84.81 ± 2.43^{abcde}	193.28 ± 0.09^{efg}
10236	Orange	8.67 ±0.47^{e}	8.84 ± 0.80^{cd}	0.11 ± 0.05^{cdefg}	0.53 ±0.01	82.66 ± 1.74^{cdef}	381.96 ± 0.20^{bc}
11085	Orange	8.20 ±0.40^{ef}	7.28 ± 0.09^{ef}	0.08 ± 0.03^{efg}	0.51 ±0.01	91.38 ± 3.48^{ab}	322.19 ± 0.24^{cd}
11090	Orange	7.49 ±0.30^{efg}	6.33 ± 0.36^{efg}	0.07 ± 0.02^{g}	0.47 ±0.01	85.54 ± 0.05^{abcde}	261.30 ± 0.24^{defg}
11092	Orange	7.40 ±0.38^{efg}	7.18 ±0.08^{ef}	0.09 ± 0.01^{defg}	0.49 ±0.04	83.88 ± 1.59^{bcdef}	300.01 ± 0.29^{cd}
Orange	Orange	5.59 ±0.03^{h}	5.94 ± 0.85^{fgh}	0.17 ± 0.03^{abc}	0.49 ±0.02	86.63 ± 3.36^{abcd}	253.17 ± 0.35^{defg}
10120	Purple	16.40 ±0.76^{a}	14.25 ± 0.14^{a}	0.10 ± 0.02^{cdefg}	0.50 ±0.04	77.90 ± 6.73^{ef}	576.86 ± 0.37^{a}
11214	Purple	14.88 ±0.16^{b}	14.24 ± 0.91^{a}	0.07 ± 0.02^{g}	0.47 ±0.00	81.07 ± 4.03^{def}	552.03 ± 0.73^{a}
Purple	Purple	4.02 ±0.27^{i}	4.01 ± 0.16^{i}	0.20 ± 0.05^{ab}	0.52 ±0.02	90.04 ± 0.70^{abc}	187.40 ± 0.03^{fg}
Mean± std dev		8.58 ± 3.30	7.87 ± 3.09	0.14 ± 0.05	0.49 ± 0.03	82.98 ± 3.97	324.20 ± 128.48

Mean within a column followed by different superscript letters are significantly different at $p<0.05$, ^{ns} = not significant , N = Newton, Ns = Newton second

deformation relative to white-fleshed cultivar with lower moisture content (Utomo and Ginting 2021). In addition, both starch and amylose contents significantly affected the peak force deformation and hardness of the steamed sweet potato, reflecting a positive correlation ($p<0.01$) as presented in Table 6. Sato *et al.* (2018) also reported that the starch content positively correlated with peak force (r = 0.51, $p<0.01$) and hardness (r = 0.67, $p<0.01$) of deep-fried sweet potato derived from 16 genotypes as well as Yoon *et al.* (2018) in 10 Korean varieties with r = 0.64 between starch and hardness of the steamed tubers. Previous studies reported that amylose content and the proportion of amylose and amylopectin were also responsible for textural characteristics of sweet potato products, particularly hardness (Lai *et al.* 2016, Nwosisi *et al.* 2019, Wang *et al.* 2020). However, Utomo and Rahman (2015) found that amylose content had no significant correlation with hardness of the cooked tubers, while it was significant for starch content (r = 0.92). Amylose contributes to pasting and gelling properties through swelling of the starch granule prior to gelatinization and retrogradation upon cooling (Idowu *et al.* 2013, Allan *et al.* 2021). Therefore, variation on the peak force deformation and hardness could be due to varietal differences in the extent of degradation of starch and cell wall substances during cooking associated with starch swelling and gelatinization (Sajeev *et al.* 2012, Aamir *et al.* 2013, Dekker *et al.* 2014). Smaller values of hardness relative to this study results were noted in steamed tubers of white and yellow-fleshed cultivars, *c.a.* 4.48-4.96 N (Utomo and Ginting 2021), while higher values (12.3-32.9 N) were investigated in three sweet potato cultivars (Wang *et al.* 2020).

Other texture characteristics were adhesiveness, cohesiveness, springiness and chewiness. Adhesiveness is closely related to the stickiness mouthfeel of food (Nishinari *et al.* 2019). In sweet potato, it reflects the stickiness of the tuber surface after cooking in relation to starch gelatinization. High adhesiveness normally gives soft texture (Wang *et al.* 2020). Table 45shows a wide variation occurred in adhesiveness of the studied accessions. Three commercial cultivars (*White, Yellow,* and *Purple*) had lower adhesiveness values than those of 17 accessions, while *Orange* was relatively similar with some of the accessions. Based on the mean value, the samples could be simply grouped into low, medium, and high adhesiveness. Low adhesiveness was addressed to those genotypes having value ranged from 0.07 to 0.127 Ns, medium for 0.128 to 0.184 Ns, and high for 0.185 to 0.24 Ns. Ten accessions belonged to low adhesiveness group, consisting of two white, two yellow, four orange and two purple-fleshed sweet potatoes. Medium adhesiveness group consisted of three white and three yellow accessions as well as *Orange* commercial cultivar. Meanwhile, high adhesiveness group was dominated by the commercial cultivars (*White, Yellow and Purple*), and one yellow accesion (10123). In this study, adhesiveness of the steamed tuber positively correlated with its moisture content (*r* = 0.54, *p*<0.01) as seen in Table 6. Meanwhile, a negative correlation (*r* = -0.37, *p*<0.01) was found for amylose content and adhesiveness (Table 6). This means that high adhesiveness might be caused by low amylose content of the tubers. A negative correlation between amylose content and adhesiveness was also noted by Allan *et al.* (2021), however it was not significant (*r* =-0.24). The results in this study were within the range of adhesiveness (0.015-4.32 Ns) obtained by Allan *et al.* (2021) in 16 sweet potato varieties.

Cohesiveness is one of the characteristics of the product exhibiting the rate at which the material disintegrates under mechanical action or a direct function of the work needed to overcome the internal bonds of the material (Nishinari *et al.* 2019). Insignificant values of cohesiveness occurred (Table 5), indicating that all samples had similar such characteristic after cooking. Table 6 also exhibited that there was no significant correlation between cohesiveness and other attributes. However, Allan *et al.* (2021) noted that amylose content had a negative correlation (*r* = -0.53, *p*<0.05) with cohesiveness. This reflects that amylose content does not solely affect the pasting and textural properties of starch gel. The latter study observed greater values of cohesiveness in 16 sweet potato varieties (0.34-0.87Ns) relative to this study, while it was relatively lower in three cultivars (0.30-0.41Ns) reported by Wang *et al.* (2020).

Elasticity of the steamed tubers was determined through springiness measurement that is stated as "the rate at which a deformed material goes back to its un-deformed condition after the deforming force is removed" (Zhu and Sun 2019). Table 5 shows that springiness of the steamed sweet potato varied from 76.08 to 92.57%. A wide variation was found in 17 accessions and four cultivars studied as well as among the flesh color groups. The orange group showed the highest mean value, followed by white, purple and yellow groups. In this study, springiness was not significantly dictated by starch and amylose contents (Table 6). However, it had a positive correlation with adhesiveness with *r* =0.64 (*p*<0.01) as presented in Table 6, suggesting a relation between stickiness and elasticity. It seems that springiness is affected by typical changes in the starch physicochemical properties and cell structure components (cell wall and middle lamella) during cooking (Wang *et al.* 2020). Utomo and Ginting (2021) also revealed similar values of springiness (80% and 86%) for white and yellow-fleshed cultivar, respectively.

Chewiness indicates the energy required to masticate a solid food, which is calculated as a multiplication result of hardness, cohesiveness and springiness (Sajeev *et al.* 2012). Table 5 shows a wide variation of chewiness, which ranged from 170.00 to 576.86 N. The mean of all genotypes was 324.20 N, whereas it was 279.33, 328.20, 303.72, and 438.76 N for white, yellow, orange and purple group, respectively. By definition, chewiness is mathematically obtained from hardness, cohesiveness and springiness values, however in this study chewiness was only affected by hardness with a significant correlation (*r* = 0.99, *p*<0.01). Moisture content of the steamed tubers also showed a negative correlation (*r* = -0.77, *p*<0.01) with chewiness (Table 6). This suggests that chewiness is likely to be affected by the combination of moisture

Table 6. Correlation coefficient (*r*) of moisture, starch, amylose content and texture profile characteristics of 17 accessions and four sweet potato cultivar

Parameter	Moisture		Starch	Amylose	Peak	TPA Characteristics				
	Fresh	Steamed	(fwb)	(fwb)	Force	Hardness	Adhesive -ness	Springi -ness	Cohesive -ness	Chewi -ness
Moisture-fresh	1									
Moisture-steamed	0.94**	1								
Starch	-0.917**	-0.85**	1							
Amylose	-0.54*	-0.52*	0.49*	1						
Peak force	-0.72**	-0.76**	0.47*	0.50**	1					
Hardness	-0.76**	-0.83**	0.60**	0.61**	0.90**	1				
Adhesiveness	0.41	0.54**	-0.24	-0.37**	-0.36	-0.43	1			
Springiness	0.33	0.30	-0.27	0.18	-0.30	-0.32	0.64**	1		
Cohesiveness	0.19	0.13	-0.37	-0.13	0.07	0.21	0.04	0.35	1	
Chewiness	-0.69**	-0.77**	0.49	0.10	0.51**	0.99**	-0.39	-0.22	0.36	1

* = significant at P<0.05 ** = significant at P<0.01

content and hardness. Low moisture content of steamed tubers with high hardness would generate high chewiness, and vice versa.

The physical and chemical properties considerably varied among genotypes. However, it seems that texture attributes would determine the characteristics of final products. Sweet potatoes with low hardness and chewiness are suitable to be used as raw material for juice and jam such as 10217, Purple and Yellow, 10061, 10166, and 10123, while those with medium hardness and chewiness such as Orange cultivars, 11072, 10200, 11090, White, 10071 , 11092, 10168 and 11085 are suitable for products made from mashed tubers. Sweet potatoes with firm texture (10236, 10116, 10073, 11214, 10100, 10120) are tailored for flour preparation, which can be further for flour based products.

CONCLUSION

A wide variation in the chemical composition of 17 UPM sweet potato accessions and four commercial cultivars was investigated in this study, including moisture, starch, amylose, and sugar contents. Such characteristics can be also grouped or ranked for different flesh colors of sweet potatoes. Hardness measured using peak force deformation and TPA gave a positive correlation, suggesting both methods can be applied. Moisture, starch, and amylose contents individually or together may contribute to the textural properties of the steamed sweet potato tubers, resulting in a variation in the hardness, adhesiveness, springiness, and chewiness, while it was similar in cohesiveness. This relation would be useful for predicting the texture profile of steamed sweet potato cultivars as well as selection for breeding of improved varieties with desired characteristics. Hardness and chewiness would likely dictate the characteristics of the final product. Further studies are needed for the suitability identification of such sweet potato genotypes for making different food products.

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