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Research Article

Evaluation of dry matter, mealiness and starch contents of yellow-flesh cassava (*Manihot esculenta*, Crantz) genotypes in Ghana

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Abstract

This study investigated variations in cassava starch, mealiness, and dry matter content across different cassava varieties used in food and industrial applications. The main goals were to establish correlations and create a conversion chart for specific gravity, dry matter, and starch contents in nine yellow-flesh cassava genotypes in Ghana. Nine yellow-flesh cassava genotypes and one white flesh genotype were grown at three research stations across different agro-ecological zones. Specific gravity values consistently exceeded 1.0, ranging from 1.02 to 1.13, dry matter content from 16.50% to 36.51%, and starch content from 5.84% to 20.01%, with the specific gravity indicating a higher density in the cassava roots. Yellow-flesh genotypes had lower starch content than the white flesh genotype, but starch content did not significantly differ among locations. The dry matter content was closely correlated with the starch content, with starch comprising 70–90% of the dry basis. Genotypes 11B, 9A, 5B, and 12B exhibited high dry matter and starch contents, along with a mealy texture. Excellent correlations were found between the observed specific gravity and the predicted dry matter and starch amounts using regression equations. This suggests that specific gravity can serve as a valid indicator of starch and dry matter content. The generated specific gravity conversion chart is a valuable tool for assessing starch and dry matter in cassava varieties, aiding in better selection for food and industrial applications.

1. Introduction

The economic value of cassava products relies on their dry matter and starch contents. The performance of cassava starch and dry matter in various applications, such as food, feed, and industry, varies depending on the variety from which the product is derived [1, 2]. In Ghana, several cassava varieties are recognized by farmers for their high dry matter and starch content, mainly because most of the cassava produced and consumed is processed into *gari* and *fufu*. Genetic analyses suggest that the inheritance of the root dry matter content in cassava is influenced by polygenic additive factors [3]. According to Barima et al. [4], cassava dry matter content varies among different genotypes, ranging from 17% to 47%, with the

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majority falling between 20% and 40%. Values exceeding 30% are considered high. The dry matter content in cassava roots can also fluctuate from 15% to 45%, depending on factors such as crop age, genotype, and environmental conditions [5, 6]. The dry matter of cassava tuberous roots has become a significant characteristic for researchers and consumers, particularly those who boil the roots as *ampesi* or process them into *fufu*. Cultivars with higher dry matter content are preferred by most users due to the positive impact on extraction efficiency during cassava processing for flour or starch [3]. Tan and Mak [7] emphasized the importance of high dry matter content, especially when using cassava roots as food, feed, or industrial raw materials. However, most studies report lower dry matter values in yellow-flesh varieties, mainly due to the higher moisture content in the roots. Conversely, Ukenye et al. [8] found a higher dry matter content in white-flesh varieties, compared to yellow-flesh varieties. Aniedu and Omodamiro [9], on the other hand, reported higher dry matter content for yellow-flesh cassava varieties compared to white-fleshed varieties. Two methods are available for determining the dry matter content of cassava. Jennings and Iglesias [10] introduced the specific gravity method, which provides a quick and efficient way to assess root dry matter content. On the other hand, the forced oven drying method [10] is more laborious, especially when dealing with large samples, and it becomes impractical in areas with no access to power or energy sources. In this study, the specific gravity method was used as an alternative approach to determine the dry matter content of cassava tubers. The primary component of cassava roots is starch [11], making them suitable for various applications in the food, feed, and industrial sectors. The functionality of starch in cassava is influenced by factors such as variety, environmental conditions, and age of the crop [12]. Studies have reported variations in starch quantity in cassava, with values ranging from 13.6% to 35.8% [13]. The starch yield obtained from cassava roots depends on factors such as cultivar, maturity, extraction method, and cultivation practices. Additionally, the starch composition in cassava roots increases with the accumulation of dry matter [14]. While the starch content in cassava can be determined through chemical or enzymatic methods, starch yield refers to the amount of starch physically recoverable from cassava roots. In the production of custard powder, the use of starch derived from yellow-flesh cassava roots has gained popularity in food formulations and composite flour preparations in Nigeria, contributing to the prevention and minimization of vitamin A deficiency [15]. However, studies have shown that the total starch content in forty yellow-flesh cassava varieties is relatively low, compared to white and cream-flesh varieties [8, 9, 16]. Numerous studies have demonstrated a correlation between specific gravity, dry matter, and starch content [17]. Specific gravity conversion tables are available in various countries for determining the dry matter and starch contents in cassava [18, 19]. However, there is a notable absence of calibration for this method concerning yellow-flesh cassava roots harvested under diverse environmental conditions, soil types, age at harvest, and other factors. Additionally, specific gravity, dry matter, and starch content conversion charts have not been developed for yellow-flesh cassava varieties in Ghana. Consequently, the primary objective of this study was to establish a relationship and construct a conversion chart for specific gravity, dry matter, and starch contents in nine yellow-flesh cassava genotypes in Ghana. Furthermore, the study investigated the relationship between dry matter content and mealiness in yellow-flesh genotypes. Specific gravity, dry matter, and starch content were selected as key parameters because they are reliable indicators of cassava root quality and processing potential. Specific gravity provides a quick and non-destructive estimate of both dry matter and starch content, which directly influences the texture, mealiness, and suitability of cassava for various food and industrial uses. Therefore, evaluating these parameters is essential for identifying high-quality genotypes that meet consumer and processing preferences in Ghana.

2. Materials and methods

2.1. Study area

The study was conducted at the Alexander Gyandoh Carson Technology Laboratory, University of Cape Coast, Cape Coast, from March - May 2020. The area has a temperature and relative humidity of 30-36 °C and 60 -70%, respectively.

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2.2. Experimental materials

The cassava tubers were obtained from three research stations located in three distinct agro-ecological zones in Ghana. These research stations include the Teaching and Research Farm at the University of Cape Coast, the Commercial, Teaching, and Research Station at Wamaso, and the Asuansi Research Farm in the Abura-Asebu-Kwamankese District in the Central Region. A total of ten genotypes were collected, consisting of nine yellow-flesh genotypes (9A, 8A, 6A, 1A, 12B, 1011A, 14B, 5B, and 11B) and one white-flesh genotype (6F).

2.3. Determination of specific gravity

Soil particles were removed from the freshly harvested roots, which were then peeled and washed thoroughly with water. The ends of the roots were neatly trimmed to achieve a uniform shape. To facilitate weighing and easy removal from the beaker, the roots were tied together using a thin thread, ensuring that they did not touch the beaker walls. The specific gravity was estimated using the following formula [20] below:

$$Sg = \frac{\text{Weight of tuber}}{\text{Loss of weight in water}} \quad (1)$$

2.4. Determination of dry matter content (DMC)

The dry matter content (DMC) was determined as a percentage by selecting three representative storage roots. These roots were washed, peeled, and sliced using a knife. Randomly selected slices were weighed to obtain a 200 g fresh sample per genotype, which was then dried for 48 h in an oven at 105 °C. After drying, the samples were re-weighed to obtain the dry mass. The percentage of DMC was calculated using the formula:

$$DMC = \frac{\text{Sample dry weight}}{\text{Sample fresh weight}} \times 100 \quad (2)$$

2.5. Determination of starch content

The cassava samples, (200 g.) were sliced and blended with 500 mL of water for five minutes using a blender. The resulting pulp was washed over a sieve with an additional 500 mL of water, and the fibrous material retained on the sieve was discarded. The obtained starch slurry was filtered through a cheesecloth into a plastic container. After approximately 4 h of standing, the supernatant was drained away, leaving behind the pure white starch in the plastic container. The starch was then dried until a constant weight was achieved using an analytical balance.

The percentage was calculated as

$$\text{Starch (\%)} = \frac{\text{Starch weight}}{\text{Fresh weight}} \quad (3)$$

2.6. Using equation to confirm dry matter (DM) *and starch content*

The heritability of dry matter (DM) in cassava is relatively high, with a broad-sense heritability estimated at 0.87 and a narrow-sense heritability ranging from 0.51 to 0.67 [3]. The estimation of DM and starch content in cassava is based on a linear relationship with the specific gravity. The percentage of DM was calculated using the following equation:

$$\text{Percentage DM} = 158.3x - 142 \quad (4)$$

While starch content was determined using the following equation:

$$\text{Starch content} = 112.1x - 106.4 \quad (5)$$

Where, x represents the specific gravity in both cases.

2.7. Mealiness

Mealiness is a crucial trait for quality assessment during the breeding of cassava. It serves as a method to evaluate the cooking quality of different cassava genotypes. To prepare the samples, each root was thoroughly washed to remove all soil particles, and then sliced into four equal parts. These sliced samples were then cooked for 25 min on a gas cooker. To assess mealiness, a small portion of the boiled sample was pressed between the thumb and index fingers. If the sample felt soft and formed a sticky paste, it was considered mealy and suitable for dishes like '*ampesi*' or '*fufu*'. On the other hand, if the sample was hard and difficult to press, it was classified as non-mealy. Non-mealy genotypes can be used for '*agbelima*' or dried for '*konkonte*' or processed into *gari*. The scale for measuring mealiness ranged from 1 to 4, where 1 represented a non-mealy texture, 2 indicated mealy, 3 denoted very mealy, and 4 indicated excellent mealiness [21].

2.8. Statistical analysis

Data collection and cleaning were performed using Microsoft Office Excel 2019. Subsequently, statistical

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Table 1. Mean specific gravity, dry matter content (DMC) and starch contents at UCC, Wamaso and Asuansi.

Genotypes	UCC			Wamaso			Asuansi		
	Specific Gravity	DMC (%)	Starch (%)	Specific Gravity	DMC (%)	Starch (%)	Specific Gravity	DMC (%)	Starch (%)
9A	1.09^{ab}	30.64^{ab}	15.86^{ab}	1.09^{abc}	32.60^{abc}	17.20^{a}	1.09^{bc}	32.00^{ab}	16.82^{ab}
8A	1.05^{bc}	25.21^{b}	12.01^{b}	1.05^{cd}	25.23^{d}	12.02^{bc}	1.07^{d}	28.25^{d}	14.82^{d}
6A	1.06^{b}	28.14^{b}	14.17$_{b}$	1.10^{abc}	32.16^{abc}	16.93^{a}	1.09^{bc}	31.91^{bc}	16.75^{bc}
1A	1.07^{b}	35.60^{a}	19.40^{a}	1.10^{abc}	33.40^{abc}	17.85^{a}	1.11^{ab}	34.79^{ab}	18.79^{ab}
12B	1.06^{b}	26.92^{b}	12.96^{b}	1.05^{cd}	26.44^{bcd}	12.91^{bc}	1.08^{cd}	29.27^{cd}	14.89^{cd}
1011A	1.06^{b}	26.92^{b}	13.22^{b}	1.06^{bcd}	27.14^{bcd}	13.40^{b}	1.09^{bc}	31.35^{bcd}	16.36^{bcd}
14B	1.05^{bc}	24.95^{b}	11.83^{b}	1.04^{d}	23.15^{d}	10.55^{c}	1.02^{e}	20.60^{e}	8.70^{e}
5B	1.06^{b}	26.72^{b}	13.08^{b}	1.06^{bcd}	27.18^{bcd}	13.30^{bc}	1.08^{cd}	30.40^{cd}	15.69^{cd}
11B	1.06^{b}	27.23^{b}	13.44^{b}	1.06^{bcd}	27.44^{bcd}	13.65^{b}	1.09^{bc}	31.62^{bcd}	16.55^{bcd}
6F	1.12^{a}	35.67^{a}	19.42^{a}	1.12^{a}	35.74^{a}	19.46^{a}	1.13^{a}	36.51^{a}	20.01^{a}
Mean	1.08	28.75	14.51	1.08	29.03	14.71	1.09	30.9	15.87
Lsd	0.021	3.33	2.36	0.025	3.98	2.82	0.014	2.205	1.561
cv (%)	1.3	8.4	11.9	1.6	9.4	13.1	0.9	5.0	6.8

Means in a column with a common letter superscript are not significantly different ($p > 0.05$).

analysis was performed using GenStat (version 14). Analysis of variance was conducted to assess differences among the cassava varieties, and Tukey's comparison test and Fisher's LSD at a significance level of 5% were used to determine significant variations among them. Post-hoc test was employed at different points based on its appropriateness in dealing with type 1 errors.

For establishing the relationship among specific gravity, dry matter, and starch content, linear regression analysis was employed. In this analysis, specific gravity was considered the independent variable, whereas dry matter and starch content were considered dependent (response) variables. The specific gravity conversion data for each location are presented in a table, and the computed regression is depicted graphically for each location.

3. Results

3.1. Mean specific gravity, dry matter content and starch contents at the locations

At the University of Cape Coast (UCC), the results for cassava starch percentage exhibited significant variation among the genotypes ($p < 0.05$), is shown in Table 1. The highest starch content recorded was 19.42%, and the lowest was 11.83%. Genotype 6F displayed the highest starch content, whereas genotype 14B had the lowest starch content. Additionally, there was a significant variation ($p < 0.05$) in the dry matter content among the genotypes. The dry matter values ranged from 24.95% to 35.67%. Notably, genotypes 6F, 11B, and 9A showed high dry matter contents of 35.67%, 35.50%, and 30.64%, respectively. In contrast, genotype 14B had the lowest dry matter content of 24.95%. Furthermore, all accessions exhibited specific gravity values greater than 1.0, ranging from 1.05 to 1.12.

At the Wamaso location, genotype 6F exhibited the highest starch content of 19.46%. Genotypes 11B, 1011A, 5B, and 8A showed similar mean starch contents, with values of 13.60%, 13.40%, 13.34%, and 12.02%, respectively. Similarly, genotypes 9A (17.23%) and 1A (17.81%) displayed high starch values that were significantly different from those of the other genotypes. In contrast, genotype 14B had a lower starch content of 10.55% (Table 1). Furthermore, significant differences ($p < 0.05$) were observed in the dry matter content among the genotypes. Genotype 6F had the highest dry matter content of 35.74%, followed by genotype 1A, with 33.40%. The lowest dry matter content of 23.15% was recorded for genotype 14B. Regarding specific gravity, all genotypes exhibited values ranging from 1.04 to 1.12, with genotype 6F recording the highest value of 1.12 and genotype 14B the lowest value of 1.04 (Table 1).

At the Asuansi location, there were highly significant differences ($p<0.05$) among the genotypes for both starch and dry matter content. Genotype 6F displayed

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the highest dry matter content (36.51%), which was not significantly different from genotypes 1A (34.79%) and 9A (32.00%). On the other hand, genotype 14B had the lowest dry matter content (16.50%) (Table 1). Regarding starch content, genotype 6F recorded the highest value (20.01%), followed by genotype 1A (18.79%), while genotype 14B had the lowest starch content (5.84%). Furthermore, all the genotypes exhibited specific gravity values greater than 1.0, ranging from 1.00 to 1.13. Genotype 14B recorded the lowest specific gravity value, whereas genotype 6F had the highest specific gravity value (Table 1).

3.2. Relationship between specific gravity, dry matter and starch content

Table 2 presents the regression equations for each location, along with their means. The computed regression for specific gravity, starch, and dry matter contents showed a remarkably high coefficient of determination (R2 ≥ 0.98) and correlation (r > 0.98) for all locations. At Asuansi, a close relationship between dry matter content and specific gravity resulted in the regression equation Y = - 142.2 + 158.4X. Additionally, a close relationship between starch and specific gravity at Asuansi yielded the regression equation Y = - 107.1 + 112.8X.

Table 2. Regression equation, coefficient of determination (R^2) and correlation of the genotypes mean.

Location	Regression Equation	R^2	Correlation (r)
Asuansi	DM = - 142.20 + 158.4 x	0.99	0.99
	Starch = - 107.10 + 112.8 x	0.98	0.98
UCC	DM = - 142.6 + 158.9 x	0.98	0.98
	Starch = - 106.7 + 112.4 x	0.98	0.98
Wamaso	DM = - 142.5 + 158.7 x	0.98	0.98
	Starch = - 106.7 + 112.3 x	0.98	0.98

x = Specific gravity

Similarly, at UCC, the regression equation derived from the close relationship between dry matter content and specific gravity was Y = - 142.6 + 158.9X. Moreover, the close relationship between starch and specific gravity yielded a regression equation of Y = - 106.7 + 112.4X.

At Wamaso, the regression equation for the close relationship between dry matter content and specific gravity was Y = - 142.5 + 158.7X, while the regression equation for the close relationship between starch and specific gravity was Y = - 106.7 + 112.3X (Table 2). Graphic representations of the computed regressions based on the means for the genotypes at Asuansi, UCC, and Wamaso are shown in Figs. 1 to 3., respectively.

3.3. Mean dry matter and starch contents for the genotypes at the three locations and their mealiness

The combined analysis of variance indicated that both the dry matter and starch content were significantly influenced by the genotype (Table 3). Genotype 6F displayed the highest dry matter (35.97%) and starch (19.63%) contents, whereas genotype 11B also exhibited notable values for dry matter (33.12%) and starch (17.61%). In contrast, genotype 14B had the lowest dry matter (22.10%) and starch (10.37%) contents. Among the genotypes, 8A, 6A, 1011A, and 14B were non-mealy, each scoring 1.0. Two yellow-flesh cassava genotypes, 9A and 11B, scored 3.5, indicating that they were very mealy. The white-flesh genotype 6F excelled in mealiness, scoring 4.0 (Table 3).

3.4. Location effect on mean dry matter and starch contents

The impact of location on the mean dry matter and starch content is presented in Table 4. Although Asuansi recorded the highest dry matter content of 30.66%, there was no significant difference (p > 0.05) between the dry matter content at the three locations. Wamaso exhibited a dry matter content of 29.03%, while UCC had the lowest dry matter content of 28.75%. Similarly, across the three locations, there were no significant differences (p > 0.05) in the starch content recorded for Asuansi (15.87%), UCC (14.71%), and Wamaso (14.51%) (Table 4).

4. Discussion

The specific gravity values for all the genotypes across the three locations were consistently greater than 1.0, indicating that the cassava roots used were denser than water, which aligns with previous studies (Table 1). Similar findings of specific gravity values greater than one were reported by Teye et al. [18] and Wassu [22], who highlighted the importance of specific gravity values above 1.0 for acceptable processing.

The dry matter values obtained in this study (Table 1) showed a dependency between dry matter content

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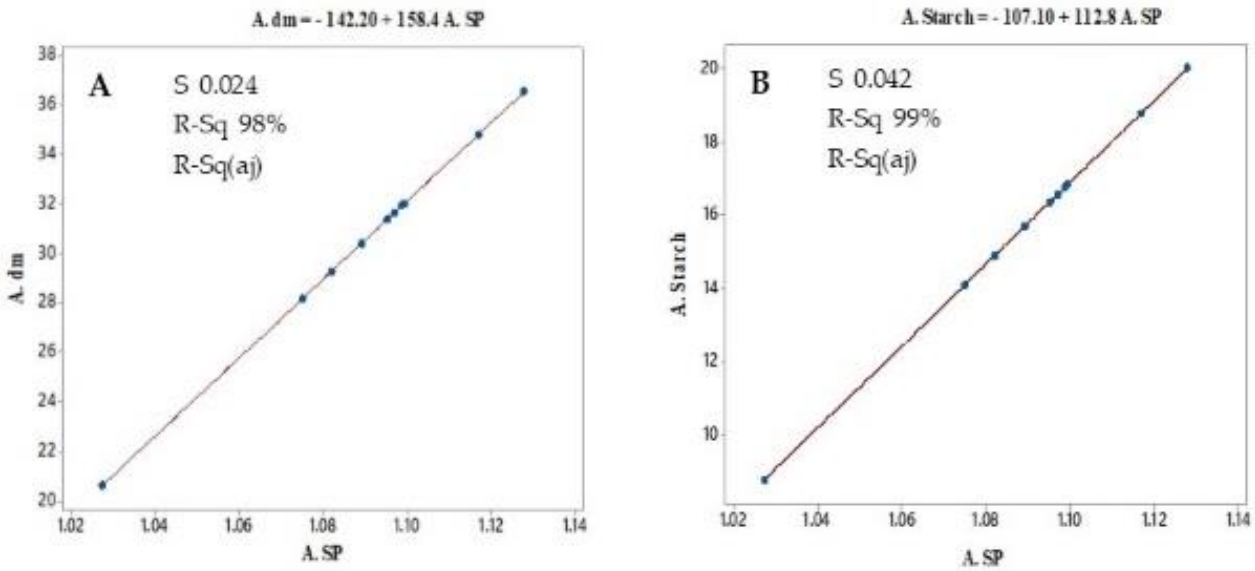

Figure 1. Linear regression of specific gravity on A). Dry matter content (DMC) on B). Starch contents of 10 genotypes with equation of best-fit line on the mean values at Asuansi.

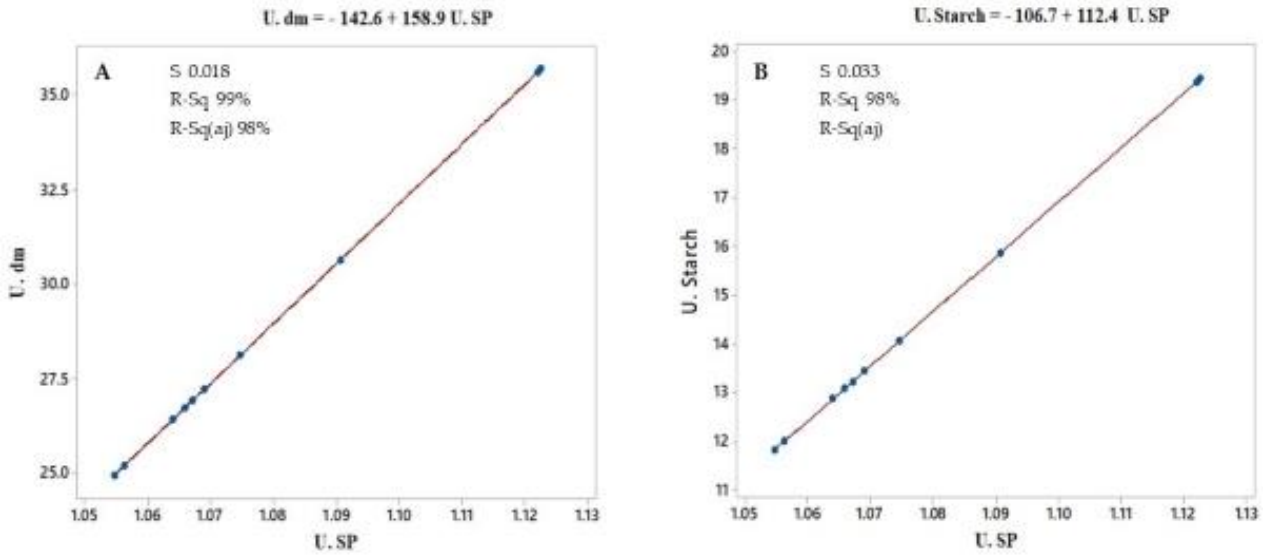

Figure 2. Linear regression of specific gravity on A). Dry matter content (DMC) on B). Starch contents of 10 genotypes with equation of best-fit line on the mean values at UCC.

The dry matter values obtained in this study (Table 1) showed a dependency between dry matter content and specific gravity, which was consistent with the findings of previous studies [4, 18, 23]. Regression analysis revealed a positive relationship between dry matter content and specific gravity, which was in close agreement with the equations reported by Teye et al. [18] and Woolfe [24]. This suggests that specific gravity can be used for a quick and convenient estimation of dry matter content, particularly in laboratories without advanced facilities. The developed relationship could be beneficial for cassava producers in selecting varieties that meet consumer preferences and market demand.

Variation in dry matter content among the genotypes was observed at different locations, indicating genetic differences and environmental influences (Table 3). The use of specific gravity as a proxy for estimating starch content was supported by the linear relationship and high coefficient of determination (r)

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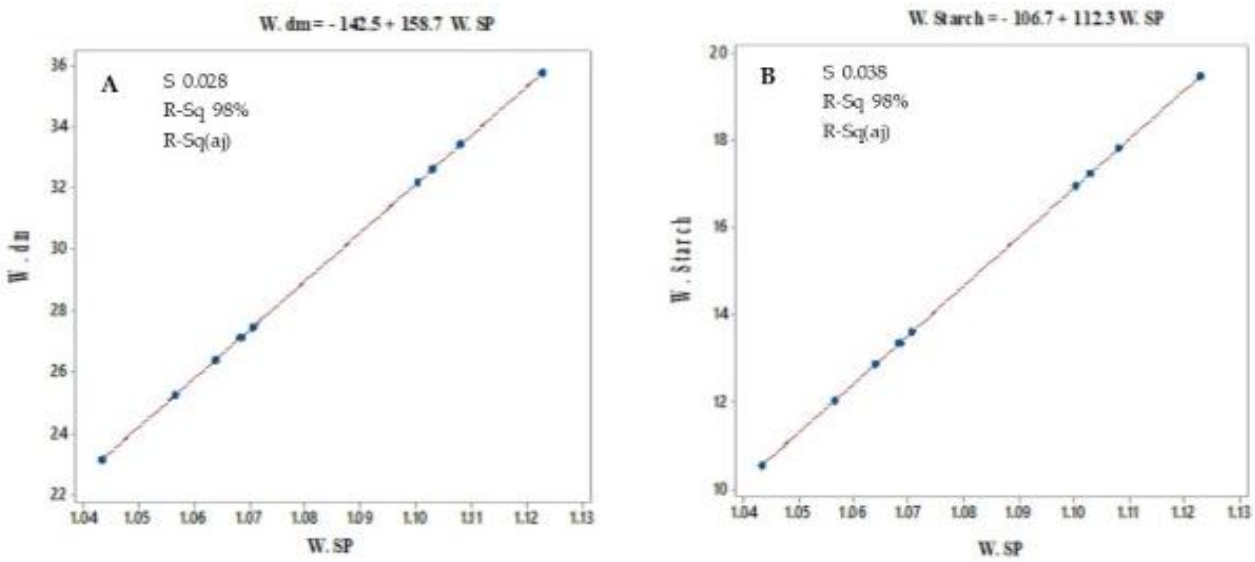

Figure 3. Linear regression of specific gravity on A). Dry matter content (DMC) on B). Starch contents of 10 genotypes with equation of best-fit line on the mean values at Wamaso.

across all locations Figs. 1 to 3. The observed variations in specific gravity and starch content among genotypes suggest the need for further exploration of genetic differences.

Across the three locations, starch content showed variability among the genotypes, with some yellow-flesh genotypes having lower starch content compared to the white-flesh variety used as a check (Table 3). These findings are consistent with those of previous studies that reported differences in starch content among yellow-flesh genotypes.

Table 3. Mean dry matter content (DMC) and starch contents for the genotypes at the three locations and their mealiness.

Genotypes	DMC (%)	Starch (%)	Mealiness
9A	29.91^{cd}	15.33^{cd}	3.5^{b}
8A	27.87^{de}	13.89^{de}	1.0^{f}
6A	26.19^{e}	12.70^{e}	1.0^{f}
1A	29.76^{cd}	15.23^{cd}	1.5^{e}
12B	29.89^{cd}	15.32^{cd}	2.5^{d}
1011A	30.65^{c}	15.34^{c}	1.0^{f}
14B	22.10^{f}	10.37^{f}	1.0^{f}
5B	28.48^{d}	14.32^{d}	3.0^{c}
11B	33.12^{b}	17.61^{b}	3.5^{b}
6F	35.97^{a}	19.63^{a}	4.0^{a}
Mean	29.48	15.03	2.217
Hsd	2.13	1.51	0.14
cv **(%)**	5.0	7.0	3.60

Means in a column with a common letter superscript are not significantly different (p>0.05).

Table 4. Location effect on dry matter and starch contents.

Location	DMC (%)	Starch (%)
Asuansi	30.66^{ns}	15.87^{ns}
Wamaso	29.03^{ns}	14.51^{ns}
UCC	28.75^{ns}	14.71^{ns}
Mean	29.48	15.03
Hsd	1.07	1.39
cv **(%)**	15.10	20.90

ns = not significant

The lower starch content in some yellow-flesh varieties may be attributed to genotypic differences and age related factors. Comparable genotype × environment effects have been reported by Chávez et al. [25] and Ntawuruhunga and Dixon [26], who found that environmental variation could alter cassava dry matter content by up to 5–8%, mainly due to soil moisture and nutrient status. Nevertheless, they emphasized that genetic factors remain the dominant source of variation, which aligns with the high heritability of DM observed in this and other studies.

The effect of location on dry matter and starch content was not significant in this study (Table 4), which differs from other studies that reported the influences of growing location on starch content. For example, Amani et al. [27] and Alves [28] observed significant site effects, where cassava grown in drier or nutrient-poor soils exhibited up to 12% lower starch yields, which they attributed this to reduced photosynthetic

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efficiency and translocation during root bulking. The absence of a strong location effect in the present study may therefore be linked to relatively uniform soil fertility or management practices across sites. This discrepancy may be due to phenotypic variations that are influenced by environmental conditions. The variations observed among genotypes across locations offer opportunities for selecting varieties that are preferred by consumers and are adaptable to different environments.

Dry matter content is crucial in cassava, as it is closely related to starch content. According to previous studies, indirect selection based on dry matter content can be employed to improve starch content. Additionally, the mealiness of cooked tubers is an essential quality parameter for Ghanaian cassava consumers. This study observed yellow-flesh genotypes with high dry matter content and good cooking quality, contrary to previous reports that indicated a negative correlation between dry matter content and mealiness. The relationship between dry matter content and mealiness is complex, as cassava mealiness is also influenced by the starch granule size.

In summary, this study sheds light on the relationship between specific gravity, dry matter, and starch content in various cassava genotypes across different locations. Specific gravity can serve as a quick and effective means estimating dry matter and starch content, offering potential benefits for cassava producers in selecting suitable varieties. The variations observed among the genotypes underscore the importance of thorough testing to identify adaptable and high-quality varieties that meet consumer preferences and market demands.

5. Conclusions

In conclusion, this study demonstrated the feasibility of determining starch content and root dry matter using specific. gravities. The regression analysis revealed strong correlations between the measured specific gravity and the predicted dry matter and starch amounts. This finding suggests that specific gravity measurements, along with the specific gravity conversion chart developed in this study, can serve as reliable indicators of starch and dry matter content. Genotype was found to be a significant factor contributing to the variation in the specific gravity, starch content, and dry matter content. Specifically, certain yellow-flesh genotypes, such as 11B, 9A, 5B, and 12B, exhibited high levels of dry matter and starch contents and were deemed very mealy. These improved genotypes possessing desirable attributes are likely to be well-received by consumers in Ghana, where varieties suitable for *ampesi* and *fufu* preparations are preferred.

We recommend that cassava breeding and quality evaluation programs adopt specific gravity as a preliminary screening tool for identifying genotypes with high dry matter and starch contents. The conversion equations developed in this study should be validated under broader environmental conditions to ensure consistency and accuracy. Future research should also examine the biochemical and structural bases of mealiness and its correlation with starch properties, to guide the development of improved, consumer-preferred varieties.

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Authors' contributions

Conceptualization, methodology, investigation, data curation, writing – original draft preparation, E.O.A.; supervision, funding acquisition research and approved final draft, PAA.; validation, methodology, writing - original draft preparation, supervision, K.J.T.; conceptualization, original drafting, data curation, visualization, resources, and final draft approval, formal analyses, J.Y.A.; data curation, visualization, resources, G.A.; investigation, methodology, resources, writing - review and editing, A.D.; funding acquisition, visualization, formal analysis, A.T.A., D.M.W., A.O.Z., K.A.

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Availability of data and materials

Upon request, data will be made available according to the journal policy.

Conflicts of interest

The authors declare that we have no conflict of interest.

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