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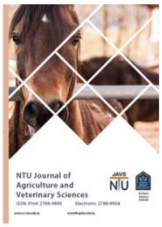

Qualitative characteristics, chemical composition and determination of apparent amylose content for some Iraqi local rice varieties

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The aim of this study was to explore the qualitative qualities and determine the nutrient content (moisture, fat, protein, fiber, ash, carbohydrates, dietary energy) as well as to determine the apparent amylose content of both yasmin and sadri varieties. The study was conducted at the University of Mosul in the laboratories of the College of Agriculture and Forestry on 1/2/2024.The physical characteristics of the specific weight, length and thickness of rice grains and the weight of one thousand grains were measured, as well as the chemical composition and the percentage of amylose and amylopectin in starch The results indicated that the specific weight of the yasmin rice variety obtained the lowest value of 78.08 kg / hectoliter, while the sadri variety obtained the highest value recorded 80.14 kg / hectoliter As for the length of rice grains, the lowest average length was recorded for the yasmin rice variety 5.16 mm, while the highest average grain length was recorded for theRice sadri 6.33 mm.As for the thickness of rice grains, the lowest thickness of the rice variety was recorded 1.75 mm, while the highest thickness of the rice variety was recorded Yasmine 2.06 mm. As for the weight of one thousand grains, the lowest weight was recorded at 14.88 g for the yasmin rice variety, while the highest weight was recorded at 17.88 g for the Sadri rice variety.As for the chemical composition, the results indicated that the lowest moisture content was recorded for the yasmin rice variety, which amounted to 10.644%, while the highest percentage of moisture content was recorded for the rice variety Sadri 11.568%. In terms of fat content, the lowest percentage was recorded for the yasmin rice variety, which amounted to 0.875%, while the highest percentage was recorded for the rice variety Sadri 1.106%. As for the protein content, the Yasmine variety got the lowest percentage of 7.937%, while the Sadri variety got the highest percentage of 8.275%.In terms of fiber content, the lowest percentage of rice was recorded for the Sadri rice variety with an average of 0.171%, while the highest percentage of fiber content was recorded for the Yasmine rice variety, which amounted to 0.224%.In terms of ash content, the lowest percentage was recorded for the Sadri rice variety, which is 0.309%, while the highest percentage of ash content was recorded in the Yasmine rice variety, which is 0.455%. As for the carbohydrate content of the two types of rice, the lowest value was recorded for the rice variety Sadri, which amounted to 78.571%, and the highest value for the rice variety Yasmine 79.865%. In terms of food energy, the lowest value of rice was recorded for breast, which is 357.34 calories / 100 g, while the highest value of energy was recorded for the yasmin rice variety, which amounted to 359.09 calories / 100 g.The results of the amylose content indicated that the Sadri variety obtained the lowest value of 17.09%, while the highest value was recorded for the yasmin rice variety, which is 22.54%. As for the content of amylopectin, the lowest value was recorded for the yasmin rice variety, which is 77.46%, and the highest percentage for the rice variety is 82.96%.

Introduction

One of the most important cereal crops consumed as a staple food worldwide for centuries is rice (*Oryza sativa* L.) also has a significant and effective contribution to achieving food security [1,2]. Rice is a predominant crop and is also vital to global food security, as it is consumed by most of the world's poor [3], with an estimated annual production in 2020 of 509 million tonnes through an area of 16 million hectares planted with rice in about 100 countries [4]. In 2021, the total global production of rice reached 525 million tons, and about 90% of it was produced and consumed in Asia. The continent also produces excess for export to the rest of the world, especially sub-Saharan Africa as well as countries with low rice production [5]. Since rice is the main food consumed in most societies, its nutritional value strongly affects the health of the consumer, especially with regard to small communities and families because most of their food depends on rice, which is at the expense of other foods rich in nutrients, so increasing and improving the nutritional value of rice is beneficial to human health [6]. Rice is not only the food crop that comprises a number of diets in the daily human diet in the world, but it is the most traded and famous crop among crops that depend on a source of carbohydrates because its protein is free of gluten, whether for people with celiac disease or those who suffer from kidney intolerance (a bowel disorder) or otherwise, which is a protein that does not provoke allergies, but rather an inhibitor of it Hypoallergic type [7,8]. The most important nutrients contained in rice are starch, protein and fat, and their quantities, composition and types in cereals in general and in rice in particular play an important and significant role in the quality of these grains and their physiological and culinary properties. The quality of rice (i.e. appearance, cooking and nutritional quality results, grinding and processing quality) is not affected by the nutrient composition of rice grains, but also by the physical and chemical properties and content of rice grains, as well as by their sensitivity to external environmental conditions. Therefore, clarifying the relationship between the main nutrients in rice and the advantages or characteristics of grain quality traits is morally important in theory and of effective value in practice for continuity in improving the quality of rice in the future. It is therefore necessary to know the effect of starch, protein, fats and mineral elements on the characteristics and quality advantages of rice produced [9]. The amylose content is key to the digestion of rice starch, but the digestibility of starch varies between rice varieties when the amylose content is the same, meaning that non-starchy rice components are likely to play a role in estimating the digestibility of starch. The speed of starch digestion depends on the size of the starch granules, starch crystallization, amylose content, length of amylopectin chains, and non-starchy components such as fiber, protein, lipids and polyphenols [10].

Rice is obtained in different shapes and varieties, including white, brown or containing dye, or in a colored form, including white, red or black, depending on its content of dyes or according to the shape of seeds or caryopsis shape to be long, short, cylindrical or spherical, or relative to the composition or texture of rice. In turn, white rice varieties are the most cultivated and consumed varieties, unlike colored varieties, whose cultivation is limited to small areas in some countries of the world such as Italy, France and North Africa [8,11].

Materials and Methods

Used rice varieties

In this study, two varieties of rice (*Oryza sativa* L.) were used, one from Najaf Governorate, the Amber Yasmin variety, and the other from the Directorate of Agriculture of Akre (Akri) Sadri variety.

Preparation and preparation of samples

After obtaining the rice varieties from their sources, they were prepared and prepared to conduct the required tests for research and preparation of the required cooking. Proper quantities of these varieties were cleaned by manually removing impurities and dirt represented by broken grains, exotic grains and stones. Through the use of sieves with a diameter of 20 × 2.2 mm, these varieties were screened more than once to ensure their cleanliness, then they were packed in sealed polyethylene bags and part of these quantities were placed in the refrigerator to prevent insect infestation and the other section was placed in a cool and dry place until use.

Physical Determination of rice Grain

1-Specific Weight (Kg.ha^{-1})

The standard method [12] of the year 2000c and mentioned by [13] with a volume of 250 cm3 was followed in estimating the specific weight of the various rice varieties, with some modifications. The equation below was also used to convert the weight to one hundred liters of rice in kilograms, as follows: Specific gravity (Kg.ha^{-1}) = weight of a quart in grams * 4 * 100 /1000.

2-Length and Thickness of the Grain

For the purpose of measuring the length and thickness of the grain, samples were taken randomly and then measured using a Chuan

Lu/0.01/mm device of Chinese origin, as shown below:

Figure(1) Rice kernel traits estimator

3-Weight of 1000 kernel (g)

One hundred grains were randomly counted and the samples were weighed using a sensitive electronic balance. The process was repeated for three repetitions, and through the equation the weight of a thousand grains was calculated. [13] Weight of one thousand grains = weight of one hundred grains *10

Chemical determinations of rice

Moisture Determination: The percentage of humidity was estimated in a conventional oven Proodit 59-10026 Italian made according to the standard method [12,14].

Fat Determination: The percentage of fat in the samples was estimated using Soxolite extraction units and using the solvent petroleum ether with a boiling point of 60-80°C up to ten times. Syphoning, as per [15,14].

Protein Determination: Protein was determined by the Micro-Kjeldahl method [12] by determining the nitrogen in the sample and multiplying the result by the factor (5.7) for the grain.

Ash Determination: The ash in the samples was determined according to the method mentioned in [15,13] using a Muffle Furnace at a temperature of 550 °C for 3 hours until a material of a grayish-white color was obtained.

Crude Fiber Estimation: The method mentioned in [15,14] was used to estimate crude fiber using acid and base digestion.

Carbohydrate determination: The carbohydrates of the sample were estimated by calculation The difference is 100, according to what [16] stated, as follows: Carbohydrates = 100 - (% moisture + % protein + % fat + % ash + % fiber).

Starch Determination Preparation and determination of starch

Preparation of starch from samples Starch extraction

The starch was extracted from rice samples according to the method mentioned by the researcher [17] after the samples were dried in order to get rid of the largest possible amount of moisture available in the grains for placing these samples in air dryers (air current) at a temperature of 40 ° C until the weight is stable and then grinded by a mill type 859 - Gosonic Grinder GCG Chinese origin and sift the results by a sieve size of openings 150 microns and then taken from the quantity obtained after sieving 25 g of sample powder and added to a local solution of pure sodium chloride with a concentration of 20% and leave the mixture after that refrigerator at a temperature of 5±2 ° C for 24 hours after the passage of time separates the formed precipitate from the filtrate by the siphon process or the use of centrifugation and then wash the mixture with water three times and the washing water was also disposed of by the siphon process or the use of centrifugation after which a sieve was used with a sieve with a size of 75 microns to get rid of the coarse parts and results obtained from it were washed with 20% ethanol alcohol and then the fat layer was isolated from the starch by washing it using a mixture of methanol/chloroform (1-2) volume/volume. Then add to the starch a quantity of water and put in the centrifuge at a speed of 4000 rpm for 15 minutes in order to get rid of the remnants of proteins that form a brown layer over the starch after which this layer can be removed by a spoon and repeated the process three times until it is sure that the layer is completely removed after washing the starch by acetone and left to dry at room temperature and then used in the tests required of them to estimate amylose.

Amylase Determination

The amylose content in rice was estimated using the method mentioned by researcher [18],which relies on using a solution of Urea Dimethyl sulphoxide after extracting starch from the samples, then reading the obtained solution with a spectrophotometer of Chinese origin at a wavelength of 630 nm. Then the apparent amylose content was calculated using... Next article:- % of amylose = absorbance *10/amount of starch *weight of sample / weight of solvent + (temperature -20°C) *0.05074 Then the amount of amylopectin is calculated through the difference between the amount of amylose and the amount of starch in the sample.

Statistical Analysis

The Social Program Statistics System (SPSS) was used for statistical analysis, and the arithmetic averages were compared based on the analysis of variance (ANOVA) test, while the differences between the groups were determined by using the Multiple Duncan's test [19] with Completely Randomized Design (CRD) and at a significant level ($P \leq 0.05$).

Results and Discussion

Table (1) shows the characteristics and characteristics of the grains of the studied rice varieties that include the specific weight of the grains, as the lowest specific weight of cereals was recorded for the yasmin variety, which amounted to 78.08 kg / hectoliter, while the highest specific weight was recorded for the rice variety Thoracic with a score of 80.14 kg/hecholeliter, noting a

significant difference at the level of (P≤ 0.05). Where this result was consistent with the values mentioned by[13], which amounted to 78.04 kg / hectoliter, although the results agree, it is relatively high compared to the acceptable limits of 70 kg / hectoliter, as the decrease in value from the permissible limit may lead to an impact on the amount of flour produced, as this is an indication of the characteristics of wrinkled and immature seeds, and it is also considered a slightly low value for those found [20], when studying the varieties of wheat of both European and Canadian types, where the specific weight is defined as a measure of the weight of grains or seeds in the field of grains and oilseeds [21]. The specific weight is also an important means to detect both the standard of density of samples, the quality of grinding index, the amount of flour produced, and it is also one of the useful and important tests in determining the extent of grain fullness by comparing it with the weights of a fixed size of grain samples, as this is considered Evidence of the index of high or low percentage of flour resulting from grinding Specific weight is also one of the most important factors that play a role in influencing grain grading systems around the world. The size, shape and regularity of the grain and the conditions to which the crop is exposed during the planting season or when harvesting is done, such as infection of wheat, for example, with diseases, as well as drought and shrunken grains as a result of high or low temperatures, or when the grains weigh immature, are all considered to affect weight. Specific grains in general [13,22,20].

Table (1) also shows the characteristics and characteristics of the grains of the studied rice varieties, which include the length and thickness of the grains, as the lowest length of the yasmin rice variety was recorded, which amounted to 5.16 mm, while the highest length of rice grains was recorded in the sadri rice variety, which reached 6.33 mm. Noting that there are significant differences (P≤ 0.05) between the mentioned values.

In Table (1) shows the values of the thickness of the grains of rice studied, the table shows the variation between the thickness of the grains of rice studied, as the lowest thickness of the rice variety was recorded at 1.75 mm, while the highest thickness of the rice variety was recorded Yasmin, which is 2.06 mm. Noting that there are significant differences (P≤ 0.05) between the values of the thickness of the grains for the two types of rice. The results of the specific weight and dimensions of the rice grains such as the length and thickness of these varieties of rice are close and consistent with the results obtained by [23](78.4 kg/hectoliter), (6.75-7.01 mm) and (2.02-2.10 mm), respectively for a number of similar rice varieties. Also, these values for rice lengths and thickness estimated in this study are consistent with the values found by [24] in estimating the lengths of many types of white and brown rice grains and many random rice samples. However, all these results are consistent and fall within the range of results found by [25] for grain dimension traits of a large number of basmati rice varieties. The size, dimensions and geometric shapes of the grains are important botanical characteristics that indicate the productive value of rice grains [26]. The size of rice grains is also an important characteristic that is used globally in estimating the grades and classification of rice. Therefore, rice is classified in relation to three classes: short, medium and long grains depending on the length of the grain, the length/width ratio, the circumference of the grain or a combination of the two [27]. The relationship between grain size and its characteristics or characteristics, including grain length, grain width or thickness, kernel circumference ratios and kernel thickness, are all factors that determine and estimate the weight and productivity of grains and are usually largely controlled by identifying a number of genetic factors [28].

Table 1 also shows the qualitative qualities of seeds and kernels of the rice varieties studied. It is noted from the table that the weight of 1000 grains (Thousand Kernel Weight, TKW) for rice samples recorded the lowest weight, which is 14.88 g for yasmin rice grains, while the highest weight of the rice variety was recorded at 17.88 g. Therefore, it is noticeable that there are significant differences (P≤ 0.05) between the weights of one thousand grains in the two types of rice, and it may be due perhaps to the differences between the different varieties of rice in which the size and dimensions of the grain vary. The weight of one thousand grains in the field of seed circulation and evaluation is an important measure and guide in the evaluation of grain yield. It is one of the important measures in the selection and breeding of cereal varieties such as wheat and rice[29].The weight of a thousand grains is not only an important indicator of grain productivity and the quality of flour produced, especially in wheat, but also an indication of the strength of germination and regeneration, which includes the speed of germination, the speed of growth, and consequently its impact on the amount of output [30].[31] have stated that the weight of a thousand grains is closely related to grain size characteristics such as kernel length, kernel width, kernel thickness, as well as the ratio of length to grain width. [32] confirmed that the value of the weight of a thousand grains in wheat, for example, is an important outcome of the quality of the grain fullness and degree of maturity, as it gives a good indication of the amount of flour crop resulting from grains.[20] stated that measuring the weight and dimensions of grain grains is important to reach information that helps in knowing the percentage of flour resulting from grinding grains, as the greater the weight of a thousand grains and

the greater their dimensions, the higher the percentage of flour extracted from grains.

Table 1. represents the qualitative characteristics of rice varieties

Rice varieties	Specific gravity	Bead length, mm	Bean thickness, mm	Weight of one thousand grains, g
yasmin	78.08±0.07 b	5.16±0.16 e	2.06±0.025 d	14.88±0.71 d
sadri	80.14±0.12 a	6.33±0.55 d	1.75±0.035 e	17.88±0.10 b

The numbers represent averages of 3 repeaters
The difference of letters vertically indicates the existence of significant differences at the level of (P≤0.05).

Chemical Composition of Rice Varieties

Table (2) shows the chemical composition of the local rice varieties Yasmin and Sadri, as the moisture content of the yasmin rice variety ranged from 10.644%, which is less than the moisture content of the Sadri rice variety, which amounted to 11.568%, and it is noted that there is a significant difference (P≤0.05) between the moisture content ratios of the rice samples under study. These results were among the values mentioned by researcher [33], which ranged between 10.04 and 12.88% in a study he conducted on some different varieties of Malaysian rice, including white, brown and colored.

Table (2) shows the percentage of fat in the studied samples, where the lowest percentage ranged for the yasmin rice variety, which amounted to 0.875%, and the highest percentage was for the sadri rice variety, which amounted to 1.106%.It was also noted that there was no significant difference at the level of (P≤ 0.05) between the values, which were within the values mentioned by [14], which ranged between 0.58-1.16% in a study of some types of rice, including amber (Mishkhab) and Aqrawi.

Table (2) shows the percentage of protein in the studied samples, the lowest percentage ranged for the yasmin rice variety, which amounted to 7.937%, and the highest percentage of protein in the rice variety is 8.275%, and it is noted that there were no significant differences at the level of (P<0.05) between the values, which were within the values found by [34] in a study conducted for some varieties of local rice in Indonesia, which ranged between 5.80 – 9.66%.

Table (2) shows the percentage of fiber in the studied samples, where the lowest percentage ranged in the Sadri rice variety, which amounted to 0.171%, and the highest percentage was for the Yasmin rice variety, which amounted to 0.224%, where significant differences were observed at the level of (P≤ 0.05) between the collected values, which were less than the values obtained by [14], which amounted to 0.46 and 0.44% for the Amber and Aqrawi rice varieties, respectively. The function of dietary fiber leads to increased satiety due to longer digestion, so varieties with a high percentage of dietary fiber will be suitable for consumption because it gives an increased feeling of satiety [34].

Table (2) shows the percentage of ash in the studied samples, where the lowest percentage ranged for the rice variety of Sadri, which amounted to 0.309%, and the highest percentage for the rice variety Yasmin, which amounted to 0.455%, noting that there is a significant difference between the values collected at the level of (P≤ 0.05) and the results were similar to the values of the researcher[34], which ranged between 0.57-1.67%. The ash content of rice indicates or reflects the mineral content of rice, as the increased ash content value of rice samples, and vice versa, the low ash content reflects the low nutrient content [34].

As for the carbohydrate content, it is calculated by the results of the chemical composition of the rice components through the difference between the components and carbohydrates. Where it was noted from Table (2) that the lowest percentage of carbohydrates was for the rice variety and the highest percentage for the yasmin rice variety, noting that there were no significant differences at the level of (P≤ 0.05) between these samples, which were consistent with a number of rice analysis results by [33,35,34]. These results ranged from 74.33% to 80.14%. Carbohydrates as the main components of cereals make up more than 70% of dry weight[36].

As for the total energy calculated through the components of Table (2) for the two types of rice, the lowest value was the food energy of the rice variety Sadri, which amounted to 357.34 Kcal / 100 g, and the highest value for the yasmin rice variety, which amounted to 359.09 Kcal / 100 g.

In general, the chemical composition of rice varies according to species, varieties, production conditions, manufacturing influences and environmental factors[37,38].

Table 2. Represents the Chemical Composition of Local Rice Varieties (g/100g)

Rice varieties	moisture	fat	protein	fiber	ash	*carbohydrates	Energy: calories/100g
yasmin	10.644 bc	0.875 a	7.937 a	0.224 ab	0.455 a	79.865 a	359.09 bc
sadri	11.568 a	1.106 a	8.275 a	0.171 b	0.309 b	78.571 a	357.34 c

The numbers represent 3 repeaters
* Calculated by the difference between the sum of ingredients except carbohydrates
The difference of letters vertically indicates the existence of significant differences at the level of (P≤0.05).

Amylose and amylopectin

Table (3) shows the content of amylose in the southern yasmin rice varieties and the northern sadri The northern thoracic variety got the lowest value of 17.04%, while the southern variety Yasmin obtained a higher value of 22.54%, where a significant difference was observed between the values obtained at the level of (P≤0.05), where the low percentage of amylose for the northern thoracic variety was compatible and close to the values obtained by [39] in his study on the percentage of amylose in some varieties White rice, such as Vietnamese, Italian and Australian, amounted to 16.67, 16.92 and 21.37%, respectively, which was used to make sushi. The values obtained were also within the range mentioned by [40],which ranged between 0-30% for some varieties of rice. The southern yasmin and northern thoracic rice varieties can be classified on the basis of the amylose content from medium (20-25%) to low (12-20%) according to the above [41].

Table (3) shows the content of amylopectin in the southern yasmin rice and northern breastfeeding varieties, where the lowest value was for the yasmin rice variety, which amounted to 77.65%, while the northern variety obtained the highest value of 82.97%, where a significant difference was observed between the values at the level of (P≤0.05). These percentages were among the values that amylopectin should form in the starch granule samples in rice, which[42]referred to, where they were between 65-85% and may reach 100% when waxy mutations occur. It is also somewhat consistent and close to the values indicated by[43],after their study to determine the content of amylose and amylopectin in improved and traditional rice varieties commercially available in Sri Lanka, which amounted to 71.7-79.6%.

Table 3. represents the content of rice starch from amylose and amylopectin

Rice varieties	Amylose%	Amylopectin%
yasmin	22.54 c	77.65 b
sadri	17.04 d	82.97 a

The numbers represent averages of 3 repeaters
The difference of letters vertically indicates the existence of significant differences at the level of (P≤0.05).

Conclusion

1- The specific weight of the yasmin rice was less than the specific gravity of the breast variety, while the length of the rice grains of the yasmin variety was less than that of the sadri variety, while the thickness of the yasmin variety was higher than that of the sadri variety, while the weight of a thousand grains of yasmin rice was less than that of the sadri variety.

2- The nutritional content of the Yasmin rice variety in terms of moisture, fat, and protein was lower than that of the Sadri variety for the same content, while the Sadri variety was higher in its content in terms of fiber, while the content of the Yasmin variety of ash, carbohydrates, and the calories it provided was higher than the Sadri variety.

3- The Yasmin rice content was higher in terms of its content of amylose and lower in amylopectin compared to the Sadri variety, whose content was lower in amylose and higher in amylopectin.

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