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PHYSIOCHEMICAL AND COOKING PROPERTIES OF RICE TREATED WITH DIFFERENT DRYING METHODS

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ABSTRACT: The effect of drying methods on physicochemical and cooking properties of rice (Sakha 101) was studied. Paddy rice samples were subjected to four different drying methods, raw or reference rice) which was dried by ambient air ventilation, sun drying, hot air drying and roasting drying. Also, puffed snacks from rice grains were produced from rice samples. The results showed that, a grain of rice filled, a grain of rice filled ratio, a grain of rice empty and a grain of rice empty ratio for testing sample were 9.15 g, 91.5%, 0.85 g and 8.5%, respectively. While in the reference sample were 9.67 g, 96.7%, 0.33 g and 3.3%, respectively. There were no significant differences in the protein contents among the rice samples treated with different drying methods. However control sample which possessed the significantly highest protein content (6.64%), moisture, fiber and amylose were 14.33, 1.40 and 21.34% respectively compared with the other rice samples treated with other drying methods. Contents of moisture, fiber and amylose decreased by increased drying temperatures. In addition, control sample contained lower contents of fat (0.85%) compared with the other rice samples treated with other drying methods, contents of fat and ash increased by increased drying temperatures. The drying methods had affected the amylose contents in dried paddy rice. Amylose contents decreased by increased drying temperatures.Control sample had the highest cooking time (21.40 min) and water absorption (3.62), but it gained the lowest rehydration ratio (1.42), while roasting dried sample showed the lowest cooking time (19.70 min) and water absorption (2.40), but it gained the highest rehydration ratio (1.68).The cooking time and water absorption decreased when the drying temperature increased. Puffed rice sample prepared from control dried rice which recorded higher puffed yield (84.70%) and expansion ratio (2.28), while recorded lower expansion volume (2.24 ml/g) and bulk density (0.77) compared with other treatments. There were no significant differences in all the proximate chemical composition in all treatments expect amylose content. Puffed rice sample prepared from control dried rice recorded higher amylose content (18.34%) compared with other treatments. Puffed rice sample prepared from control dried rice recorded higher scores for all organoleptic characteristics compared with the other salty puffed rice. In addition, all salty puffed rice samples showed high acceptability scores.

Key words: Physiochemical, puffed rice, amylose, cooking time, organoleptic, expansion value, paddy rice.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal grain grown in the world. It is the staple food of nearly half of the world population. It is a regular Asian diet, usually taken as a whole grain after cooking, contributing about 40–80% of total calorie intake (**Sarowar *et al*., 2009; Papillo *et al*., 2018**). It is mostly consumed at household level as boiled or fried rice. The preference for taste, colour, and stickiness of rice varieties varies among different cultures. The two most important cultivated species of rice are *Oryza sativa* and *Oryza glaberriumn*.

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Oryza sativa is grown in most parts of the Asian and American continents, whereas *Oryza glaberriumn* is grown only in Africa. Indica (long grain), Japonica (round grain), and Jayanica (medium grain) are three subspecies of rice grown in world. Rice consists mainly of carbohydrates in the form of starch, 72–75% of which contributes to the total grain composition. About 7% of protein mainly glutelin is present in rice. The glutelin present in rice is also called as oryzenin (**Rather *et al*., 2016)**.

For the designing of equipment for handling, conveying, separation, dehulling, drying, storage, and other processes, physical properties of rice need to be studied. Knowledge of principle axial dimensions of a grain is useful in power calculation for milling and sieve selection for separation (**Singh *et al*., 2015**). They can also be useful in calculating volume and surface area of kernel which are important in modeling of grain drying, heating, cooling, and aeration. Density values are useful in sizing grain hoppers and storage facilities. Rate of heat and mass transfer during aeration and drying depends upon density values of grains (**Malik and Saini, 2016**).

The enzymatic activity may increase and accelerate lipid degradation during storage, in addition to reducing the sensory quality of rice (**Ding *et al*., 2018).** Therefore, post-harvest techniques such as the drying process, which involves the reduction of seed moisture content to a safe level, can be applied to guarantee the preservation of physiological and physical-chemical quality of the product to be stored during a long period of time (**Sousa *et al*., 2016**). However, many of the properties of agricultural products are affected by the drying conditions (**Dehghannya *et al*., 2016; Santos *et al*., 2019**).

Since the drying process affects the milling yield and head rice quality, a proper drying method to lower the moisture content of paddy rice to 12–14% (w.b.) is crucial. During drying, the heat flow induces the development of moisture and temperature gradients and thermal stress inside the rice kernel، leading to the formation of fissures on the kernel. Usually, fissured kernels break easily during milling causing a serious reduction in the head rice yield, cooking qualities and market value (**Kumoro *et al*., 2019**).

The cooking qualities of rice determined their economic values, which can be measured in terms of cooking time, grain elongation during cooking, and length breadth ratio after cooking. Cooking quality depends upon the physical and chemical characteristics of starch, such as amylose–amylopectin ratio, gel consistency, and gelatinization temperature (**Tan *et al*., 1999**). Amylose content is one of the important characteristics influencing the cooking behavior (**Xie *et al*., 2007**). Rice variety with more than 25% of amylose content absorbs more water and has a fluffy texture after cooking (**Frei *et al*., 2003**).

Several researchers in recent times have investigated the drying characteristics or behavior of food using different drying methods such as open sun drying (**Falade and Omojola, 2010; Afolabi and Agarry, 2014**), solar drying (**Doymaz, 2011; Ismail and Ibn Idriss, 2013)**, hot-air drying (**Tüfekçi and Özkal, 2017**), heat pump drying (**Li *et al*., 2019**), vacuum freezing drying (**Huang and Zhang, 2016**) and infrared drying (**Tanta and Doymaz, 2019).**

The aim of this work was to investigate the effect of some drying methods on physicochemical of rice (Sakha 101) properties after cooking. Also, the study was conducted to investigate the possibility of using different rice treatments to produce salty puffed rice as a snack food.

MATERIAL AND METHODS

Material

Egyptian rice (*Oryza sativa* L.) namely Sakha 101 (short grain Indica/Japonica) , employed in this study was obtained from Rice Research and Training Center (RRTC) at Sakha, Kafr El-Sheikh Governorate, Egypt during the season of 2019, under the recommended conditions for date of culture, fertilization, harvesting time and irrigation. Frying oil, table salt, chili and cumin were purchased from local market, Zagazig, Egypt. All chemicals used were of analytical reagent grade.

The mechanical harvesting of rice crop was carried out at grain moisture content up to 24%, for the safe storage of rice grains; this requires reducing the humidity to 14%. So, the rice grain must be decrease the moisture content by using many methods for drying the grains; such as make sun-drying, convective drying and roast drying (**Ojha and Michael, 1996**).

Methods

Harvesting Methods

Due to the high wages of agricultural workers; because the most of them were leaving their work in the farms and go to industrial cities. So, the most Egyptian farmers have resorted to harvesting rice fields in the best mechanical way, which is (combine), it is consider the best machine for rice harvesting in terms of: low grain loss rate, low cutting level, less costs and less time for harvesting and threshing. And thus the evacuation fast of the land for the next crop. For the more, the important to apply good harvesting methods to be able to maximize grain yield and minimize grain damage and quality deterioration.

Two rice harvesting systems were used:

-Traditional harvesting: By using sickle and

-Mechanical harvesting: By using combine.

Traditional Harvesting

Paddy rice harvesting activities include reaping, stacking, handling, threshing, cleaning, and hauling. These can be done individually or team work by using sickles.

Mechanical Harvesting

Using full mechanization for harvesting rice crop save time, effort, and total cost requirements and also clear the rice crop from the field as fast as possible than traditional system (**Moheb, 2007**).

The specifications of combine harvester (Kubota)

Type: CA-385 EG Japan,

Model: Turbo diesel, 4strokes, water cooled, 3 cylinders,

Overall length: 4.063m,

Overall width: 1.904m,

Overall height: 2.000m and

Weight: 1979kg.

The optimum performance of combine device

The optimum performance of combine device was determined during harvesting operation of rice crop, the total grain losses and criterion costs was minimum and performance efficiency was maximum under following conditions:

- Forward speed of 2.1 km/h,
- Cutter bar speed of 1.2 m/s for both rice,
- Cylinder speed of 25 m/s
- Concave clearance of 9.0 mm and
- Grain moisture content of 22.30 %, **Hassan *et al*. (1994)** and **Kamel (1999)** and **El-Khateeb (2005).**

Experimental drying processing of rice

This study examined the effect drying methods on quality of milling grains and cooking properties of Rice (Sakha 101). Rice samples were subjected to four different drying methods as following: conventional drying (reference rice sample), sun drying, hot air drying and roasting drying.

Conventional drying (reference rice sample) of paddy rice

After harvesting by using sickle, the plants leaved in the sun for 10 to 12 day to reduce the moisture content of the grains.

In this method the grains are still attached to the panicles. It is a traditional method for drying small amounts of paddy rice. The panicles are harvested with sickle; after that the hills was bound together and carried to the threshing location for drying for 10-12 day. The bundles are placed on mats and turn the bundle every period. After that when the grains were arriving to the optimum moisture content, the farmers are separating the grains from the stem manually.

Sun Drying of Paddy Rice

The sun drying operation was conducted at 7.00 a.m– .12.00 p.m. by evenly spreading 5 kg of paddy rice onto a concrete floor or tarpaulin, while keeping the rice layer thickness to about 2–5 cm.The temperature, relative humidity and velocity of the ambient air during the experiments were 35.9 ±1.65°C, 41.5 ±3.15% and 3.47 ±0.41 m/s، respectively. The paddy rice was then exposed to direct sunlight, wind and other atmospheric conditions (**Paddy Drying, 2013**).

During the drying process, the moisture content of the paddy rice was measured at 30 min intervals using a moisture meter, followed by a manual stirring of the paddy rice to ensure even drying.

Once the targeted moisture content of 14% (w.b.) was reached, the dried paddy rice was collected, packed into sealed plastic bags and stored in ambient conditions for further analysis(**Paddy drying, 2013**).

Hot Air Drying of Paddy Rice

The tradition of drying paddy rice with hot air in the laboratory

The drying unit in factories using hot air dries large quantities of paddy rice, up to tons for industrial purposes, and it is difficult to dry small quantities of grains for research purposes. Some researchers have assembled a laboratory unit to dry small quantities of paddy rice using hot air for research purposes (**Abd El-Hmeed and El Sayed, 2014**).

The main specifications of operating unit is shown in Fig. 1 and operating conditions in Table 1.

The main components of the drying unit

Fan

The fan is used to obtain the air current used in drying the paddy rice, through passaging the air in the warm area. Fan moves the drying air through the drying system, depending on the required airflow rate. The specification of this fan:

Model: B-BXS-35,B-BXt-35,

Power: 65 Watt and

Diameter: 0.35 m.

Drying bin

The bin is made of perforated metal sheets to able the air stream to pass through the bin easily. The bin is manufactured in the form of rectangles parallel by dimensions:

Length: 0.4 m,

Width: 0.4 m,

Thickness: 0.075 m and

Volume: 0.012m^3.

Two fireplaces

The fireplaces are using to heat the cold air for drying paddy rice. The specifications of these fireplaces are:

Power source: Electricity,

Maximum electrical capacity: 1600 watt,

Type: CX-QNQ-10-12Y, Operating voltage: 220 watt and frequency: 50 hertz.

Cover

The cover is made of metal sheet in the form of parallel, rectangular, open in both directions, by height of 1.6 m, length of 0.42 m, width of 0.42 m.

Table

A flat table made of metal sheet in a rectangular shape by length of 1.8 m and width of 0.6m.

Temperature apparatus: The specifications of the apparatus, which used to determine the temperature degree of sample after different treatments were, Type: Omegatemp, Made in Germany.

The roasting drying of paddy rice

Roasting unit

Manufactory local unit and the classification are; weight 53 kg, external diameter 400 mm, thickness 50 mm, and depth 500 mm. and the heat source is biogas. The turning unit is: a turning arm that receives movement from an electric motor with a power of half a horse (**Ojha and Michael, 1996**) (Fig. 2).

Measuring instruments

Device air velocity: The air stream velocity generated by the fan was measured by the anemometer and the specification of the device were: Made in: Japan by SATAKE CO, The reading ranged: 0 to 50 m/s and Accuracy: ± 0.5 (Fig. 3).

Moisture content

Moisture content meter: For each treatment a random grains sample was taken to determine

Table 1. The main specifications of drying unit

Drying temperature.	43-45^{o}C
Air velocity.	0.22m/s
Layer depth.	0.1 m
Drying time.	5h
Initial, MC.	28%
Final, MC.	14%
Power requirement.	1.1×10^{-3} kW/kg, grain

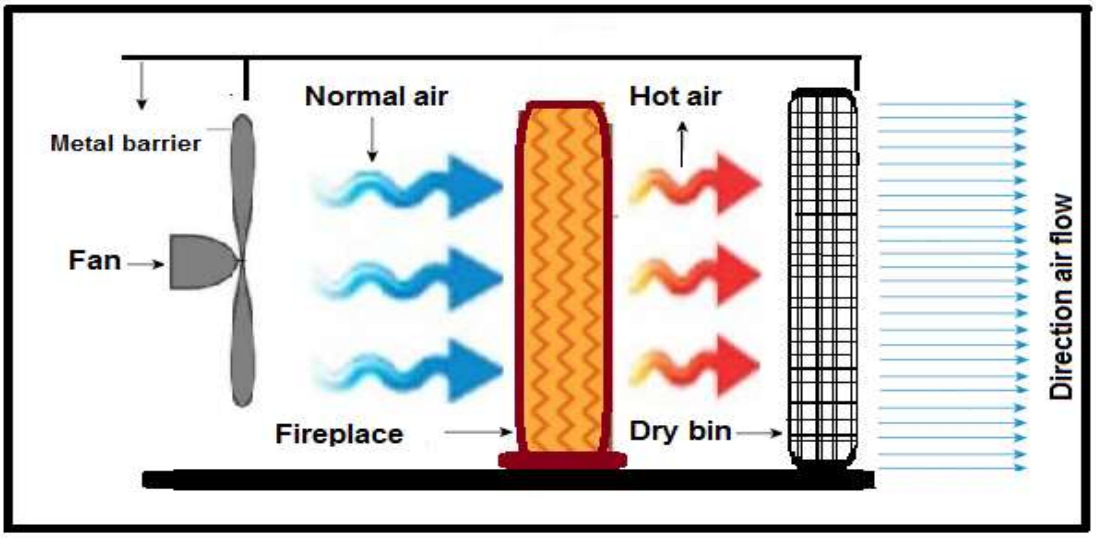

Fig. 1. Schematic diagram shows the main components of the drying unit.

Fig. 2. The photo of roasting unit

Fig. 3. Device measurement air velocity

Fig.4. Electronic moisture meter

Fig.5. Apparatus measurement grains temperature.

the moisture content by using apparatus electronic moisture meter. The specifications of this apparatus are as follows: Type: GANN Hydromelle G 86, made in Germany.

The temperature degree of sample

The apparatus specifications which was used to determine the temperature degree of sample after different treatments are Type: Omegatemp, made in: Germany (Fig. 4).

Determination of cooking quality

Water absorption

To determine water absorption, two grams of milled parboiled rice samples were added to 20 ml of distilled water previously heated at 95°C in a test tube covered with cotton plug and placed in a covered thermostatically controlled water bath. The rice samples were cooked according the cooking time in a water bath as previously determined, cooled in water, drained, and placed upside down for 1 h and weighed. The increase in weight was calculated and reported as gram of water absorbed by one gram of rice sample according to the method described by (**Juliano and Bechtel 1985**).

Minimum cooking time

Milled rice samples (2 g) were taken in a test tube from each treatment and cooked in 20 ml distilled water in a boiling water bath 100+2ºC. The cooking time was determined after 15 min by removing a few kernels at different time intervals during cooking and pressing between two glass plates until no white core was left.

Rehydration ratio

The rehydration ratio of rice samples was performed using the method of **Cao *et al.* (2016)**. Rice grains (5.08.0-g) were submerged in distilled water at 100°C, remaining under these conditions for a period of 10 min. At the end of the procedure, rehydration ratio (RR) was calculated in accordance with equation:

$$RR = Wr / Wd$$

Where RR is the rehydration ratio (g/g); Wr is the weight of rehydrated grains (g); and Wd is the weight of dry grains (g).

Preparation of salty puffed rice

Cooked milled rice grains were used to prepare puffed rice, then, the drained cooked rice was spread over a small wire-mesh trays, then dried at 40±ºC to 13- 14% moisture content. The dried cooked milled rice was expanded in an iron pan containing frying oil (180±20ºC). Afterwards, the puffed rice was allowed to cool down at room temperature on a clean marble floor. The puffed samples were measured in a 100 and 500 ml graduated cylinder. Salt, cumin seeds and red chili powder were finely ground. Then, toasted puffed rice was dusted with mixed salt and spices. It was cooled down for 3 to 4 hr and then stored it in a clean air tight container. The puffed yield, expansion volume, expansion ratio and bulk density were calculated according to **Simsrisakul (1991**).

Chemical analyses of puffed rice

The moisture, crude protein, crude fat, ash and crude fiber contents were determined according to the method described by **AOAC (2002)**. Amylose content was measured according to **Juliano and Bechtel (1985)**.

Sensory properties of salty puffed rice

Sensory properties of salty puffed rice samples were evaluated according to the method of **Shen *et al*. (2014)**. Salty puffed rice was evaluated according to their crispness, taste, colour, flavour and overall acceptability، by 10 members of Food Science Department Faculty of Agriculture, Zagazig University, Egypt. All samples were coded and presented in a randomized arrangement. Sensory assessment was analyzed using a five-point hedonic scale (1: dislike extremely, 2: dislike, 3: neither, 4: like, 5: like extremely).

Statistical Analyses

The obtained results were evaluated statistically using analysis of variance as reported by **McClave and Benson (1991)**. In addition the other reported values were expressed as mean ±SD and ±SE, two – tailed Student's t test was used to compare between different groups. P value less than 0.05 was considered statistically significant. SPSS (Chicago, IL, USA) software window Version 16 was used.

RESULTS AND DISCUSSION

Rice Filled and Empty for the Studied Samples

Table 2 shows the percentage ratio of rice grain, filled and empty for the studied samples. It can be seen that, a grain of rice filled, a grain of rice filled ratio, a grain of rice empty and a grain of rice empty ratio for testing sample were 9.15 gm, 91.5%,0.85 gm and 8.5%, respectively, while in the reference samples were 9.67 gm, 96.7%, 0.33 gm and 3.3%, respectively. It is important to know this to determine the effect of different drying methods on the rate of milling and the integrity of the grains after the milling process.

Effect of Drying Methods on Chemical Composition of Paddy Rice

Proximate chemical composition of the paddy rice under study is shown in Table 3.

Table 2. The percentage ratio of rice grain filled and empty in the studied samples

Item	Control(Reference)	Testing sample
A grain of rice filled, gm	9.67±0.44^{a}	9.15±0.50^{b}
%A grain of rice filled ratio,	96.7±2.28^{a}	91.5±2.84^{a}
A grain of rice empty, gm	0.33±0.08^{b}	0.85±0.05^{a}
%A grain of rice empty ratio,	3.3±0.18^{b}	8.5±0.12^{a}

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).

Table 3. Effect of drying methods on chemical composition of baddy rice

Rice Treatment	%Chemical					
	Moisture	Crude Protein	Crude Fat	Ash	Crude Fiber	Amylose
Control drying	14.33±0.44^{a}	6.64±0.34^{a}	2.83±0.22^{d}	4.22±0.14^{b}	1.40±0.18^{a}	21.34±0.50^{a}
Sun drying	14.30±0.50^{a}	6.12±0.46^{bc}	3.09±0.30^{c}	3.89±0.20^{c}	1.08±0.26^{b}	20.24±0.64^{b}
Roasting Drying	14.00±0.40^{a}	6.27±0.32^{b}	3.37±0.36^{b}	4.81±0.12^{a}	0.92±0.34^{bc}	19.74±0.72^{c}
Hot air Drying	14.15±0.42^{a}	6.25±0.40^{b}	3.82±0.40^{a}	4.75±0.16^{a}	0.85±0.40^{bc}	20.13±0.46^{b}

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).

There were significant differences in the crude protein content among paddy rice samples treated with different drying methods. Control sample possessed the significantly highest protein content (6.64%). Also, control sample contained higher contents of moisture, fiber and amylose with 14.33, 1.40 and 21.34% respectively compared with the other rice samples treated with other drying methods. Contents of moisture, fiber and amylose decreased by increased drying temperatures. In addition, control sample contained lower contents of crude fat (2.83%) compared with the other rice samples treated with other drying methods. Crude fat and ash contents increased by increasing the drying temperatures. The chemical composition of paddy rice agree with those reported by **Mariey *et al*. (2016)**.

Amylose content was determined as a function of the drying treatments. The results indicated that the drying methods had affected on the amylose contents in dried paddy rice. Amylose contents decreased by increasing drying temperatures, these results agree with those reported by **Wiset *et al*. (2001)**.

Effect of Drying Methods on Cooking Quality of Milled Rice Grains

Results showed that, control sample had the highest cooking time (21.40 min) and water absorption (3.62), but it gained the lowest rehydration ratio (1.42), while roasting drying sample showed the lowest cooking time (19.70 min) and water absorption (2.40), but it gained the highest rehydration ratio (1.68). The cooking time and water absorption decreased ($p < 0.05$) when the drying temperature increased (Table 4). Opposite behavior was observed for rehydration ratio. The increase in drying temperature promotes greater cellular disruption, increasing the rehydration ratio (**Sehrawat *et al*., 2016)**.

Table 4. Effect of drying methods on cooking quality of milled rice grains

Treatment	Cooking quality		
	Cooking time(min)	Rehydration ratio	Water absorption
Control drying	21.40±0.65^{a}	1.42±0.04^{d}	3.62±0.16^{a}
Sun drying	20.80±0.46^{b}	1.50±0.05^{c}	3.56±0.14^{ab}
Roasting Drying	19.70±1.04^{d}	1.68±0.12^{a}	2.40±0.20^{c}
Hot air Drying	20.10±1.12^{c}	1.55±0.08^{b}	3.48±0.18^{b}

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).

The reduction in the cooking time and the increase in the rehydration ratio in rice dried when the drying temperature increased are consistent with the increase in the intensity of the fissures formed during the drying process. The increase in grain cracks reduces the distance traveled by water from the surface to the interior of the grains, facilitating hydration and reducing cooking time (**Lang *et al*., 2018**). These results agree with data reported by **Tirawanichakul *et al.* (2012) and Lang *et al*. (2018)**.

Quality characteristics of the prepared puffed rice

The quality characteristics of puffed rice sample is presented in Table 5. Puffed rice sample prepared from control dried rice recorded higher buffed yield (84.70%) and expansion ratio (2.28), while recorded lower expansion volume (2.24 ml/g) and bulk density (0.77) compared with other treatments.

Puffing and popping quality of paddy having strongly positive correlation with amylose content which plays an important role in the expansion ratio of rice kernels, higher the amylose content, the higher expansion ratio during puffing (**Madhuri, 2002**). **Maisont and Narkrugsa (2010)** found that, high amylose content resulted in a hard product with low expansion. However, the exact effect of amylose content on puffing quality of rice was not cleared yet, because many other researchers also reported that amylose content had negative correlation with both expansion volume and puffing percentage (**Bhat Upadya *et al*., 2008; Joshi *et al*., 2014)**. These results are in agreement with reported by **Galal *et al*. (2019).**

Proximate Chemical Composition on Dry Weight of the Prepared Puffed Rice

Proximate chemical composition of different puffed rice samples is shown in Table 6. There were no significant differences in all the proximate chemical composition in all treatments expect amylose content. Puffed rice sample prepared from control dried rice recorded higher amylose content (18.34%) compared with other treatments. These results agree with results obtained by **Galal *et al*. (2019)**.

Organoleptic Characteristics of the Prepared Puffed Rice

Organoleptic characteristics of the salty puffed rice (crispness, taste, colour, flavour and overall acceptability) are given in Table 7. The results indicate that, puffed rice sample prepared from control dried rice recorded higher scores for all organoleptic characteristics compared with the other salty puffed rice. In addition, all salty puffed rice samples showed high acceptability scores. These results are in the line with those reported by **Galal *et al.* (2019)**.

Table 5. Quality characteristics of the prepared different puffed rice

Characteristic	Puffed rice treatment			
	Control drying rice	Sun drying rice	Roasting drying rice	Hot air Drying rice
Puffed yield%	84.70±0.42[a]	84.22±0.54[ab]	82.84±0.62[c]	83.78±0.44[b]
Expansion volume (ml/g)	2.24±0.30[a]	2.02±0.28[ab]	1.68±0.24[c]	1.92±0.26[b]
Expansion ratio	2.28±0.34[a]	2.10±0.30[ab]	1.50±0.28[c]	1.94±0.32[b]
Bulk density (g/ml)	0.77±0.02[d]	0.86±0.05[c]	1.14±0.09[a]	0.98±0.04[b]

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).

Table 6. Chemical composition, on dry weight, of the prepared different puffed rice

Chemical%	treatment			
	Control drying rice	Sun drying rice	Roasting drying rice	Hot air drying rice
Moisture	5.94±0.24[a]	5.90±0.32[a]	5.88±0.18[a]	5.92±0.24[a]
Protein	7.48±0.10[a]	7.46±0.28[a]	7.48±0.18[a]	7.50±0.12[a]
Fat	3.86±1.15[a]	3.88±0.42[a]	3.84±1.04[a]	3.90±0.18[a]
Ash	0.64±0.16[a]	0.66±0.09[a]	0.64±0.12[a]	0.68±0.10[a]
Fiber	0.78±0.08[a]	0.76±0.10[a]	0.76±0.12[a]	0.78±0.06[a]
Amylose	18.34±0.14[a]	18.02±0.18[b]	16.94±0.22[d]	17.76±0.18[c]

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).

Table 7. Organoleptic characteristics of the prepared different puffed rice

Characteristic	treatment			
	Control drying rice	Sun drying rice	Roasting drying rice	Hot air drying rice
Crispness(5)	4.40±0.32[a]	4.30±0.44[a]	4.20±0.52[a]	4.30±0.60[a]
Taste(5)	4.50±0.52[a]	4.50±0.34[a]	4.50±0.46[a]	4.50±0.54[a]
Colour(5)	4.40±0.48[a]	4.40±0.56[a]	4.35±0.60[a]	4.35±0.46[a]
Flavour(5)	4.50±0.34[a]	4.50±0.44[a]	4.45±0.56[a]	4.45±0.38[a]
Overall acceptability(5)	4.45±0.58[a]	4.425±0.36[a]	4.375±0.44[a]	4.40±0.52[a]

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).

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الخـــواص الفيـــزوكيميــــائيــــة وخـــواص الطبـــخ للأرز المعـــامل بطرق تجـفيـف مختلفـــة

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تناولت هذه الدراسة تأثير طرق التجفيف على الخصائص الفيزوكيميائية وخواص الطبخ للأرز (سخا 101). تم معاملة عينات الأرز الشعير بأربع طرق تجفيف مختلفة وهي الأرز الخام أو المرجعي وهو الأرز الطازج الذي يتم تجفيفه عن طريق التهوية بالهواء المحيط في الحقل،التجفيف الشمسي،التجفيف بالهواء الساخن والتجفيف بالتحميص وتم قياس مدى تأثير تلك الطرق على معدل التصاقي للحبوب بعد عمليه التبيض للأرز، كما تم إنتاج وجبات خفيفة منتفخة من حبوب الأرز من عينات الأرز المعاملة محل الدراسة. أظهرت النتائج أن حبات الأرز الممتلئة ونسبة ملء حبات الأرز وحبات الأرزالفارغة ونسبة حبات الأرز الفارغة للعينات المختبرة كانت 9.15 جرام و 91.5% و 0.85 جرام و 8.5% على التوالي ، بينما في كانت العينة المرجعية 9.67 جم و 96.7% و 0.33 جم و 3.3% على التوالي، ولم تكن هناك فروق معنوية في محتوى البروتين بين عينات الأرز المعاملة بطرق التجفيف المختلفة ، حيث احتوت العينة الكنترول على أعلى نسبة معنوية من البروتين (6.64%)،الرطوبة،الألياف والأميلوز بنسبة 14.33 و 1.40 و 21.34% على التوالي مقارنة مع عينات الأرز الأخرى المعاملة بطرق التجفيف الأخرى، وانخفضت محتويات الرطوبة،الألياف والأميلوز بزيادة درجات حرارة التجفيف. بالإضافة إلى ذلك، احتوت العينة الكنترول على محتوى دهون أقل بنسبة 0.85% مقارنة بعينات الأرز الأخرى المعاملة بطرق التجفيف الأخرى، وزادت محتويات الدهن والرماد بزيادة درجات حرارة التجفيف. أثرت طرق التجفيف على محتويات الأميلوز في الأرز المجفف. انخفض محتوى الأميلوز بزيادة درجات حرارة التجفيف ، حيث سجلت عينة الكنترول أعلى وقت طهي (21.40 دقيقة) وامتصاص الماء (3.62) ، ولكنها حصلت على أقل نسبة إعادة تميؤ (1.42) ، بينما أظهرت عينة التجفيف بالتحميص أقل زمن طهي (19.70 دقيقة). وامتصاص الماء (2.40) ، لكنها حصلت على أعلى نسبة إعادة تميؤ (1.68) ، وانخفض وقت الطهي وامتصاص الماء مع زيادة درجة حرارة التجفيف.سجلت عينة الأرز المنتفخ من الأرز المجفف الكنترول أعلى محصول (84.70%) ونسبة تمدد(2.28) بينما سجلت انخفاضًا في حجم التمدد (2.24 مل/جم) والكثافة الظاهرية (0.77) مقارنة بالمعاملات الأخرى. لم تكن هناك فروق معنوية في جميع قيم التركيب الكيميائي في جميع المعاملات فيما عدا محتوى الأميلوز، بينما سجلت عينة الأرز المنتفخ المحضرة من الأرز المجفف الكنترول محتوى أعلى من الأميلوز (18.34%) مقارنة مع المعاملات الأخرى. سجلت عينة الأرز المنتفخ المحضرة من الأرز المجفف الكنترول درجات أعلى لجميع الخصائص الحسية مقارنة بالأرز المنتفخ المالح الآخر. بالإضافة إلى ذلك ، أظهرت جميع عينات الأرز المنتفخ المملح درجات قبول عالية.

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