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Effect of some treatments of Jerusalem artichoke tubers on the resulted powder for food process uses.

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ABSTRACT

In this study the Jerusalem artichoke tubers (*Helianthus tuberosus L)* are used for the production of powder suitable to be added to the bakery products either from the color or near the flour granules size.

The Jerusalem artichoke tubers were treated by soaking for 5 minutes with citric acid after being cut to slices thickness of 2 mm and blanched or hot steam at 100 ° C for 2 minutes and the drying on trays in an air oven drier at 65 ºC (overnight). Then grinding in two stages using a miller in order to reach to the small particle size of 300 microns, through sifting by an automatic vibrating sifter.

Several treatments were carried out before drying on the slices of the Jerusalem artichoke tubers to improve the color and size of the resulting powder particles size. The treatments were done with citric acid 0.5% and blanching or hot steam treatment at 100 ºC in addition to soaking in sodium meta-bisulfate as a source of SO_2 at concentrations of (0.5% -1.0% -1.5% and 2.0%).

The chemical determinations of the resulted Jerusalem artichoke powder (JAP) were studied with peels or without peeling. The comparison between the two treatments show that the ash and fiber content the flour with peel appeared higher amount than the flour obtained from tubers without peeling. The external appearance of the strips and the produced powder showed the best when tubers not peeled before blanching or citric acid treatment.

The study follows the effect of storage JAP for a period of three and six months of storage on the chemical properties and showed no marked changes during this period.

The JAP obtained has been studied to reduce the aggregation caused by the presence of inulin sugar by using addition of wheat flour. The finding referred to the possibility of using wheat flour at rates of 10% up to 50% to enhance this character.

KEYWORDS

Jerusalem artichoke tuber-Wheat flour- Milling - Sifting - Chemical determinations - Storage.

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1. INTRODUCTION

Many studies worked on the Jerusalem artichoke tubers (JAT) because of its components which include inulin compound and other nutrients with healthy factors. From those authors who worked on extraction of inulin from the tubers. Other researches try to obtain powder after drying the tubers. Some work make step of peeling the tubers before milling and other works keep the peel and obtain Jerusalem tuber powder (JATP) including the peel with its high fiber content and the other nutrients.

Khuenpet *et al*., (2015) in their results indicated that non-peeling blanching was the pretreatment that should be applied for Jerusalem artichoke tuber production because it provided Jerusalem artichoke tuber powder with the lowest sugars, and the benefit of blanching is to help preventing the browning reaction during JATP production.

Rubel *et al*., (2014) mentioned that the powder obtained by freeze-drying of JAT extract showed superiority compared to powders obtained by spray drying (yield), so this sample could be used as a prebiotic food ingredient as an alternative to commercial inulin obtained from chicory root.

Bach *et al*., (2013) explained why the Jerusalem artichoke tuber slices turned brown after peeling and drying due to an enzymatic browning reaction. Moreover, if the JAT slices were heated in boiling water, their colors would be darker as a result of a non-enzymatic darkening reaction between iron and phenolic acids, forming a complex of Fe^{2+} and O-di phenolic acid. When exposed to air, this complex was oxidized to a bluish-grey Fe^{3+}-O-di phenolic acid complex.

Ilga Gedrovica and Daina Karklina, (2012) reported that by increasing concentration of Jerusalem artichoke powder in pastry increased nutritional value and decrease energy or caloric value of the resulted products.

Takeuchi and Nagashima, (2011) pointed out that the samples containing Jerusalem artichoke tuber peel had more intense color when compared with samples without Jerusalem artichoke tuber peel. This was because polyphenolic normally occurs in JAT peel to a greater extent than in JAT flesh part, leading to more intense non enzymatic darkening during heating.

Yildiz, (2006) mentioned that the use of Jerusalem artichoke tuber powder that included Jerusalem artichoke tuber peel produced darker color in the resulting inulin powder, it could also increase the production yield of inulin powder due to the high content of inulin-type fructans in the peel.

For the blanching the sliced samples were immersed in boiling water for 2 min (**Takeuchi and Nagashima, 2011**), and then tap water at room temperature was applied before cooling

The Jerusalem artichoke is an agricultural crop which is of great potential for food, production of fuels, and industrial products. This crop gives a high yield in tubers, it grows better in poor soils than most crops, and it is resistant to pests and common plant diseases as well as to cold temperatures.

Mazza, (1984) found that drier load conditions of Jerusalem artichoke tuber and temperature they are very important in drying behavior, drying time and product color. Increasing the air velocity from 2.0 to 4.2 m/set, at a temperature of 65°C and a bed depth of 10.5 cm, did not change the rate for drying 1 cm^3 cubes.

2. MATERIALS AND METHODS

Materials.

-The chemicals: used in this research were purchased from El Nasr Pharmaceutical Chemicals Co., Egypt.

- Wheat flours: Wheat flour (72% extraction) was obtained from Middle Egypt Flour Mills Co. at Fayoum Governorate, Egypt.

-Jerusalem artichoke tuber (JAT): (*Helianthus tuberosus.L*), obtained from (Horticulture Research Station at Al-Kanater El-Khaireya) and plant production farm, Faculty of Agriculture, Fayoum University.

Methods.

Chemical composition.

The moisture content, lipids, protein, ash crude fiber and carbohydrate (NFE) and pH were done according to **(AOAC, 2015).**

- Water holding capacity and fat absorption capacity:

The Water holding capacity and fat absorption capacity was determined using the methods described by **Suresh and Samsher, (2013) and Ilga Gedrovica and Daina Karklina, (2012)**.

The WHC and FAC are expressed as g of water and fat per gram of the sample on a dry wt. **(Tang, 2007).**

-Treatments of JAT for powder production:

Fresh JAT (**variety JA102**) was supplied by (Hortculture Research Station at Al-kanater El-khaireya), Egypt. Raw JAT samples were exposed to the preparation and treatment procedures from washing, peeling, slicing, heat treatment, drying and finally milling and sieving.

Washing: Samples washed to remove soil and other impurities and then kept at 2°C in cold room (Fridge) before use.

Peeling: JAT samples were taken from the cold room and left at room temperature prior to the for peeling.

Slicing: A vegetable cutter is used for slicing JAT into 2 mm thicknesses.

Citric acid treatment: Immersion of the samples in 0.5% w/v citric acid solution for 5 min is done to prevent enzymatic browning.

Sodium meta-bisulfate treatment: (0.5, 1, 1.5, 2gm. / l.) solution.

Draining: The samples are drained and then laid on filter fabric tissue.

Drying: This drying temperature of 65°C was chosen based on a previous study because it provided a short drying time and acceptable product quality.

Milling: Dried JAT chips are ground into JAT powder by Pin mill at two stages.

Sifting: The JAT powders are screened through a 60 mesh sieve and through an 80 mesh sieve after the second milling.

Packaging: Final Jerusalem artichoke (JAP) powder are kept in polyethylene pouches and stored at -10° C until used.

- Particle size determination of JAP:

To analyze particle sizes of JAP, a set of sieves are used with a mechanical sieve shaker Model **M200**. Sieves with mesh No of 1000,500,300,280,250 and 215 µm are used. They are assembled in ascending order, with mesh size increasing from bottom to top, while the pan was installed below. A 20 to 30 g sample of JAP was placed on the top sieve and shaken for 10 min. The powder on each sieve was weighed. The weight was divided by the total weight to calculate the percentage of powder retained on each sieve.

- Color evaluation: The method of measuring the color was used according to **Khuenpet *et al.*, (2015).**

-Hygroscopic characteristic: This characteristic is measured according to **Hashem *et al.*, (2018).**

Table 1. Sensory evaluation method of determining color of Jerusalem artichoke powder.

Jerusalem artichoke powder Color	Degree
Bright White	10
White	9
Pale Grayish	8
Grayish White	7
Gray	6
Pale Yellow	5
Yellow	4
Dark Yellow	3
Yellowish Brown	2
Brown	1

Table 2. Sensory evaluation method of hygroscopic characteristic of Jerusalem artichoke powder.

Hygroscopic Characteristic		Aggregation degree
Lumpy powder	+++++++	1
Very Grainy powder	++++++	2
Grainy powder	+++++	3
Very coarse powder	++++	4
Coarse powder	+++	5
Fine powder	++	6
Very fine powder	+	7

ESULTS AND DISCUSSION

- Chemical composition of wheat powder and two treatments of Jerusalem artichoke powder.

Effect of particle size on the loss of nutrients from JAP .

The chemical compositions of wheat flour and for the two treatments of Jerusalem artichoke powder are shown in **Table (3)**

Table 3. Wheat flour and Jerusalem artichoke tuber and the effect of two treatments of Jerusalem artichoke powder on the chemical determinations.

Determinations	Jerusalem artichoke tuber (JAT)	Wheat flour (72%) pass through sieve (300 µ)	Jerusalem artichoke powder (JAP) Treatment 1	Jerusalem artichoke powder (JAP) Treatment 2
Moisture content	74.24	12.25	6.00	5.20
Crude protein	2.15	1٠.٧0	7.20	7.75
Crude fat	0.10	1.09	1.48	0.87
Ash	1.40	0.89	5.15	4.60
Crude fiber	4.66	0.15	7.32	6.20
Carbohydrates (NFE)	17.45	74.٩2	72.85	75.38
pH	7.10	6.53	5.82	5.94

Treatments 1 Jerusalem artichoke powder (non-peeling/blanching) sieve pass through (300 µ).

Treatment 2 Jerusalem artichoke powder (peeling / blanching) sieve pass through (300 µ).

When comparing samples with peel (JAP) and without peel (JAP), it appears that the solubility of samples without peel was slightly higher. This is because JAT peel contains more insoluble solids compounds, such as cellulose, hemicellulose, and lignin, than JAT flesh (**Rizk, 2006).**

Data showed that fresh tubers of Jerusalem artichoke contained (74.24, ٢.١٥, ٠,١٠, ١.٤٠, ٤,٦٦, and١٧.٤٥) %, for moisture, protein, fat, ash, crude fiber, and carbohydrate, respectively .Results are in agreement with those obtained by **Amin *et al.*, (2005)** who studied the chemical composition of JAP with or without peel also the chemical composition of some products prepared with JAT powder (**Catană *et al.*, 2018).**

From **Table (3)** it appeared that:

1. Moisture content: The moisture content for the wheat flour was found to be 12.25%, Jerusalem artichoke powder (Treatment 1) (300 µ) 6.00% and Jerusalem artichoke powder (Treatment 2) (300 µ) 5.20%. These results are in agreement with **Nadir *et al.*, (2011).**

2. Crude protein: From Table (٣) it appeared that the protein content for the wheat flour was found to be 10.70%, Jerusalem artichoke powder (Treatment 1) 7.20% and Jerusalem artichoke powder (Treatment 2) 7.75%.These results are in agreement with **Catană *et al*., (2018).**

3. Crude fat: the crude fat for the wheat flour was found to be 1.09%, for Jerusalem artichoke powder (Treatment 1) 1.48 % and Jerusalem artichoke powder (Treatment 2) 0.87 %. These results are in agreement with **Tortrakun *et al.*, (2019).**

4. Ash content: the ash content for the for the wheat flour was found to be 0.89%, Jerusalem artichoke powder (Treatment 1) 5.15 % and Jerusalem artichoke powder (Treatment 2) 4.60%.These results are in parallel with **Bach *et al.*, (2012).**

5. Crude fiber: the crude fiber for the wheat flour was found to be 0.15%, Jerusalem artichoke powder (Treatment 1) 7.32 % and Jerusalem artichoke powder (Treatment 2) 6.20 %.these results are in agreement with **Gómez *et al*., (2003).**

6. Carbohydrates: the carbohydrates for the wheat flour was found to be 74.92 %, Jerusalem artichoke powder (Treatment 1) 72.85 % and Jerusalem artichoke powder (Treatment 2) 75.38 %.These results are in agreement with **Hashem *et al.*, (2018)**

7. pH: the pH for the wheat flour was found to be 6.53, Jerusalem artichoke powder (Treatment 1) is 5.82 and Jerusalem artichoke powder (Treatment 2) is 5.94.These results are in agreement with

Radiana *et al.*, (2017). Blanching the sliced JAT samples in hot water for 2 min resulted in an increase of pH due to leaching of acidic substances from the sample to the water.

The moisture contents of JAP are in the range of 5.20% to 6.00% wet basis (w.b.). These moisture contents are low enough for long-term storage. Dried fresh JAT to a moisture content of about 5.20% w.b. served in preventing the brown rot.

The effect of pretreatment on the moisture content of JATP is not obvious .However, pretreatment should not directly influence the moisture content of JAP because the samples are exposed to more heat and moisture during hot water during blanching.

Table 4. Physicochemical characteristics of wheat flours and Jerusalem artichoke powder (JAP).

Determinations	Wheat flour (WF) (72%) pass through sieve (300 µ)	Jerusalem artichoke powder (JAP) with peels (Treatment 1)
Water holding capacity (g water/g dry sample).	0.50	3.70
Fat absorption capacity (g fat /g dry sample).	0.60	1.10

Physical chemical characteristic of wheat flour (WF) and Jerusalem artichoke powder (JAP) are shown in **Table (4)**. The average moisture content of WF was the highest followed by JAP, the results were 12.25% and 6%. The crude ash content of (JAP) and (WF) are shown in **Table (3)** was 5.15 and 0, 89 for (WF). The water holding capacity (WHC) and fat absorption capacity (FAC) of JAP. These results are in agreement with **(Norkulova and Safarov 2015).**

In case of water-holding capacity for the wheat flour was found to be 0.50 % and Jerusalem artichoke powder (Treatment 1) 3.70 % and the fat absorption capacity (g fat/g sample) for wheat flour was found to be 0.60 and Jerusalem artichoke powder (Treatment 1) is 1.10 % respectively. These results are in parallel with **Khuenpet *et al.*, (2015).**

The explanation of the results and increase water holding capacity for (JAP) in **Table (4)** could be due to the higher soluble, insoluble, total dietary fiber and crude ash meanwhile the wheat flour, showed decrease in water holding capacity **Cheng *et al*., (2020).**

Table 5. Technical study of production yield of JAP and physical evaluation of Jerusalem artichoke powder.

Properties	**Jerusalem artichoke powder (JAP)**			
	Without blanching		**With blanching**	
	Whole tuber	**Skinless tuber**	**Whole tuber**	**Skinless tuber**
***Yield (gm.)**	340	255	325	310
Extraction %	34.00	25.50	32.50	31.00
Color	yellowish white	white	grayish white	Yellow
****Hygroscopic characteristic**	++	+	+++	+++

***Yield: Net weight of powder in gm. / kg fresh JAT**

**** Hygroscopic characteristic: High = +++, medium = ++ and low = +.**

Physical evaluation of JAP:

Table (5) show that the highest yield of JAP (calculated as net weight of powder in gram from / kg of fresh JAT) was obtained for whole non-blanched JAP followed by whole blanched JAP, skinless blanched JAP and then skinless non-blanched JAP which were found as 34.00, 32.50, 31.00 and 25.50%, respectively. From the same Table, it could be concluded that skinless non-blanched JAP was characterized with the best color (white) than the other investigated samples. However, both whole and skinless blanched JAP was found to be more hygroscopic than other non-blanched dried samples. Skinless non-blanched JAP samples shows the lowest hygroscopic properties compared with other samples. All JAP samples obtained were found to have the same amorphous texture. These results are agreed with those found by **Rumessen *et al*., (1990).**

Table 6. Effect of processing and storage on chemical composition of dried Jerusalem artichoke.

Determinations	**Dried Jerusalem artichoke powder (Treatment 1) Pass through sieve (300 µ)**		
	Zero time	**After 3 months**	**After 6 months**
Moisture content	6.00	8.47	9.28
Crude protein	7.75	7.46	6.90
Crude fat	1.48	1.32	1.24
Ash	5.15	4.65	4.27
Crude fiber	7.32	7.22	6.56
Carbohydrates	72.30	70.88	71.75
pH	6.82	6.63	6.48

Chemical properties of JAP:

Table (6) show that the moisture (6.00, ٨,٤٧and 9.28), ash content are (5.15, 4.65 and 4.27%), protein content are (7.75, 7.46 and 6.90%) and fat content are (1.48, 1.32 and 1.24%), crude fiber were (7.32, 7.22 and 6.56%) and carbohydrate content are (72.30, 70.88 and 71.75%), for JAP at Zero time, after 3 months and after 6 months of storage respectively**.** The results are near what referred by **Norkulova and Safarov, (2015).**

Drying of Jerusalem artichoke tubers led to decrease the moisture contents from 74.24% of fresh JAT **(Table 3)** to 6.00% at zero time, meanwhile changed after 6 months to 9.28%, this increase may be related to the effect of fructose content on the absorption of relative humidity **(Abd El-Hameed., 2006) and Hashem *et al.*, (2018).**

The pH values of fresh JAT being 7.10 which decreased by drying to 6.82 at zero time and after storage period for 6 months to 6.48, while the values of total acidity at zero time and after storage for 6 months were logic when compared to the pH value, the increase period in total acidity may be related to the liberation of free phenolic acids of soluble tannins (**Markakis, 1982) and (Norkulova and Safarov, 2015).**

Also in the same **Table (6)**, ash content and crude fiber increased after drying from (1.40 and 4.66%) to (5.15 and 7.32%) at zero time respectively and decreased gradually after storage for 6 months to (4.27 and 6.56%) respectively, this decrease may be related to the effect of drying process on the degradation of some components such as pectin and hemicelluloses **(EL-Feky., 2002).**

Concerning to data in the same **Table (6)**, the crude protein content of dried J.A was decreasing during storage from 7.75% to 6.90%.

Also in **Table (6)** show also that total lipids content of dried JAP decreased during storage from 1.48% to 1.28 at zero time and after storage for 6 months, also a clear decrease from 72.30 to 71.75% was observed in total carbohydrates after drying and storage for 6 months, These results may be due to the non-enzymatic browning reaction **Barta and Pátkai**, **(2007)**.

***Sodium meta-bisulfate (0.5, 1, 1.5, 2gm. / l.).**

Table 7. Effect of treatment JAT with citric acid and SO_2 concentrations during hot steaming on the color of JAP.

	Treatments	JAP Color Degree	JAP Color statement
(JAP 1)	• Control	2	Yellowish brown
(JAP 2)	• Citric acid 0.5%	3	Dark yellow
(JAP 3)	• Citric acid 0.5% • Hot steam – 5 min.	4	Yellow
(JAP 4)	• Citric acid 0.5% • SO_2 (100 ppm)* • Hot steam – 5 min.	5	Pale yellow
(JAP 5)	• Citric acid 0.5% • SO_2 (150 ppm)* • Hot steam – 5 min	5	Pale yellow
(JAP 6)	• Citric acid 0.5% • SO_2 (200 ppm)* • Hot steam – 5 min.	5	Pale yellow
(JAP 7)	• Citric acid 0.5% • SO_2 (250 ppm)* • Hot steam – 5 min	6	Gray

Table 8. Effect of treatment JAT with citric acid and SO2 concentration during blanching on the color of JAP.

	Treatments	**JAP Color Degree**	**JAP Color statement**
(JAP 8)	• Citric acid 0.5% • Blanching 100°C - 2min.	6	Gray
(JAP 9)	• Citric acid 0.5% • SO_2 (100 ppm)* • Blanching 100°C - 2min	٧	Grayish white
(JAP 10)	• Citric acid 0.5% • SO_2 (150 ppm)* • Blanching 100°C - 2min	٧	Grayish white
(JAP 11)	• Citric acid 0.5% • SO_2 (200 ppm)* • Blanching 100°C - 2min	8	Pale grayish
(JAP 12)	• Citric acid 0.5% • SO_2 (250 ppm)* • Blanching 100°C - 2min	9	Pale white

***Sodium meta-bisulfate (0.5, 1, 1.5, 2gm. / l.).**

The previous **Tables (7) and (8)** appeared the effect of some treatments during drying the Jerusalem artichoke tubers on the color of the resulted Jerusalem artichoke slices and powder. as well as improving the grinding of the Jerusalem artichoke tubers in order to obtain small particles and to improve their ability to mix with wheat flour (WF), during kneading.

It was shown from treatment with citric acid 0.5% and sodium meta-bisulfate 1gm / l, blanching 100°C - for 2min. and drying at 60°C.

These treatments improved the color, grinding, obtaining a smaller particle size and the homogeneity of mixing with wheat flour and when using it as a fat replacer and kneading in comparison to the control sample (**Barkhatova *et al*., 2015).**

The results showed that this treatment was better than the control sample, as well as using a lower concentration of Sodium meta-bisulfate.

The effect of blanching process on the nutritional value of Jerusalem artichoke tuber flour (JAP) produced by air oven drying method:

Data presented in **Table** (7, 8): show that the influence of both blanching and non-blanching process on the effect of drying methods used on the nutritional value of whole and skinless JAT. It could be observed that protein and fat were slightly decreased when JAT was dried after blanching than without blanching.

However, as the reducing sugars increased, non-reducing sugars and inulin decreased in blanched dried tuber than those obtained in non-blanched dried tuber, respectively. The explanation of that may be due to that steam blanching may cause some loss in carbohydrate contents; in addition, heat treatment may cause conversion in some of non-reducing sugar and inulin to reducing sugar. These results are in agreement with Nadir et al., (2011).

Table 9. Effect of treatment JAT with citric acid and SO2 concentration during hot steam or blanching on particle size of JAP.

	Treatments	JAP Particle size**
(JAP 1)	• Control	+
(JAP 2)	• Citric acid 0.5%	+
(JAP 3)	• Citric acid 0.5% • Hot steam – 5 min.	++
(JAP 4)	• Citric acid 0.5% • SO_2 (100 ppm)* • Hot steam – 5 min.	++
(JAP 5)	• Citric acid 0.5% • SO_2 (150 ppm)* • Hot steam – 5 min.	++
(JAP 6)	• Citric acid 0.5% • SO_2 (200 ppm)* • Hot steam – 5 min.	++
(JAP 7)	• Citric acid 0.5% • SO_2 (250 ppm)*	++

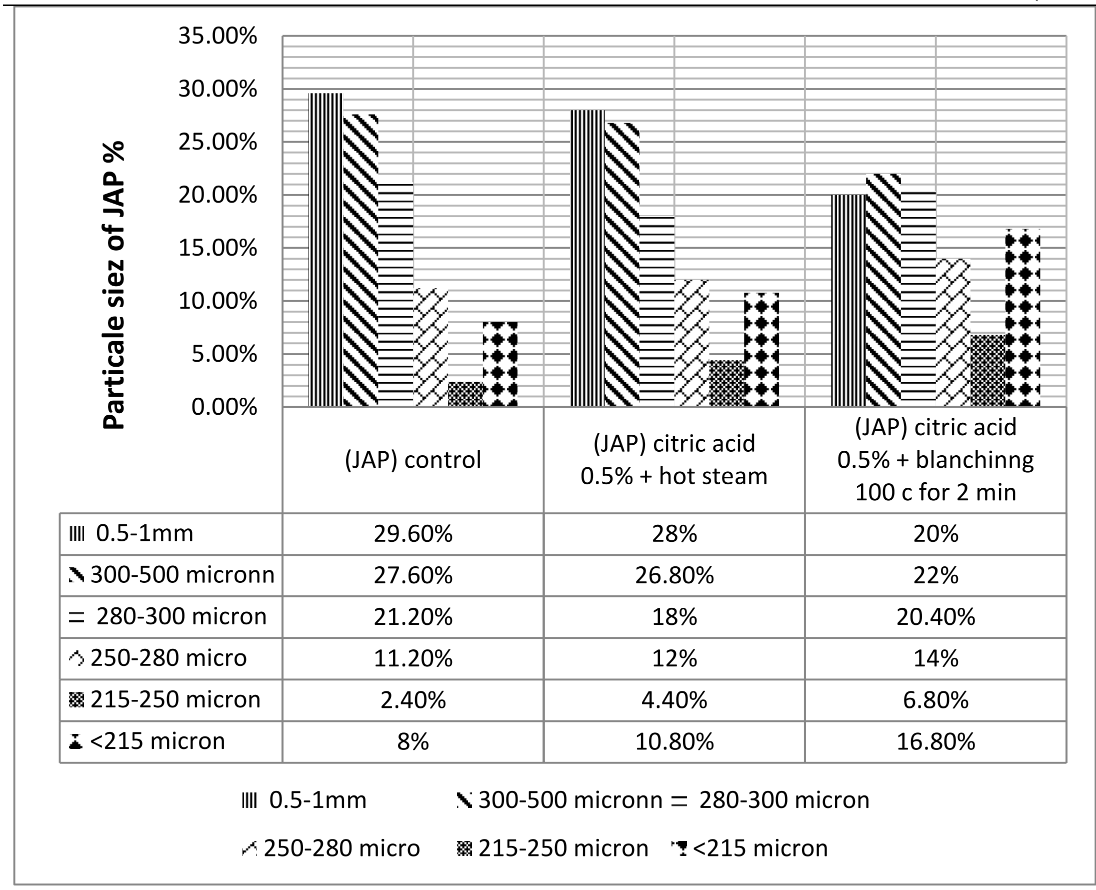
	• Hot steam – 5 min.	
(JAP 8)	• Citric acid 0.5% • Blanching 100°C - 2min.	+++
(JAP 9)	• Citric acid 0.5% • SO_2 (250 ppm)* • Blanching 100°C - 2min.	+++
(JAP 10)	• Citric acid 0.5% • SO_2 (200 ppm)* • Blanching 100°C - 2min.	+++
(JAP 11)	• Citric acid 0.5% • SO_2 (150 ppm)* • Blanching 100°C - 2min.	+++
(JAP 12)	• Citric acid 0.5% • SO_2 (100 ppm)* • Blanching 100°C - 2min.	+++

***Sodium meta-bisulfate (0.5, 1, 1.5, 2gm. / l.).**
****Particle size: large = +++, medium = ++ and small = +.**

Table 9. Effect of addition of wheat flour on aggregation of the Jerusalem artichoke powder.

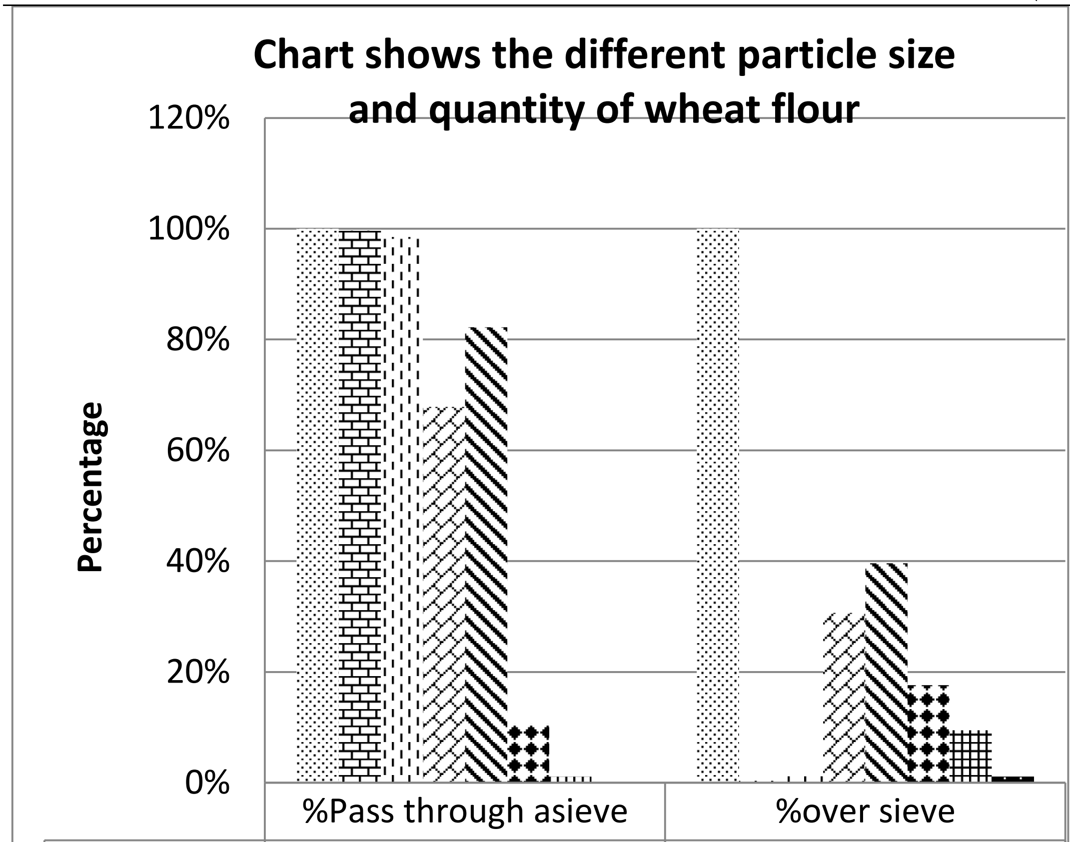
Treatment	Aggregation appearance		Aggregation degree
Control	Lumpy flour	+++++++	1
5%WF + 95%JAP	Very Grainy flour	++++++	2
10% WF + 90%JAP	Grainy flour	+++++	3
20% WF + 80%JAP	Very coarse flour	++++	4
30% WF + 70%JAP	Coarse flour	+++	5
40% WF + 60%JAP	Fine flour	++	6
50% WF + 50%JAP	Very fine flour	+	7

+++++ = High aggregation.
+ = Non – aggregation.



	(JAP) control	(JAP) citric acid 0.5% + hot steam	(JAP) citric acid 0.5% + blanchinng 100 c for 2 min
0.5-1mm	29.60%	28%	20%
300-500 micronn	27.60%	26.80%	22%
280-300 micron	21.20%	18%	20.40%
250-280 micro	11.20%	12%	14%
215-250 micron	2.40%	4.40%	6.80%
<215 micron	8%	10.80%	16.80%

Figure 1. The effect of treatment Jerusalem artichoke tubers slices with citric acid, blanching and drying on particles size of JAP.



	%Pass through asieve	%over sieve
control	100%	100%
1Ml	99.65%	0.35%
0.5 Ml	98.50%	1.15%
250 micron	67.85%	30.65%
212 micron	82.21%	39.64%
125 micron	10.61%	17.60%
90 micron	1.11%	9.50%
63 micron	0	1.10%

Figure 2. Different particle size and quantity of wheat flour.

Table 11. Effect of treatments JAT slices due to hot steam or blanching on JAP particle size.

Over sieve size (micron)	Treatment					
	Control		Hot Steam		Blanching	
	Over sieves	Pass through sieves	Over 300 micron	Pass through 300 micron	Over 300 micron	Pass through 300 micron
1000	—	١٠٠	—	100	—	100
500	29.6	70.4	28	72	20	80
300	27.6	42.8	26.8	45.2	22	58
280	21.20	21.6	18	27.2	20.4	37.6
250	11.20	10.4	12	15.2	14	23.6
215	2.40	8	4.4	10.8	6.8	16.8
Total over sieves 300	57.2%		54.8%		42%	
Total pass sieves 300	42.8%		45.2%		58%	

From **Table (11)** it is clear that those particles smaller than 125 microns increased in case of using (citric acid 0.5% + blanching 100 ℃ for 2 min) of the JAP samples in all cases of total weight. This was likely due to the application of two stages milling by pin mills. Furthermore, the blanched samples contained higher proportions of larger particles than the non-blanched specimens .

This result indicated that the blanching treatment affected the grinding and size reduction of dried JAT to more fine flour. These results agree with what stated by **Rubel *et al*., (2014)**.

3. CONCLION

From the above results obtained from this work it could be concluded;

-Treatment either by blanching or hot steam improves the color of JAP.

-The best treatment with SO2 was found in case of 50 ppm or more.

-There could be possible to enhance the JAP aggregation by addition 40 and 50 gm. wheat flour to 100 gm. of JAP.

-JAP could be stored for a period of three months up to six months without marked changes in the chemical properties.

4. REFRANCES

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الملخص العربى

تأثير بعض المعاملات على درنات الطرطوفة بهدف إنتاج مسحوق للإستخدام الصناعى الغذائى

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١- تم دراسة إنتاج مسحوق الطرطوفة المجفف بعد إجراء عمليات االغسيلوالتجهيز لدرنات الطرطوفة(*Helianthus tuberosus L*) دون التقشير أو بعد التقشيروعمل شرائح ومعاملتها بالنقع لمدة ٥ دقائق بحامض الستريك بعد تقطيها إلي شراح بسمك ٢ مم والسلق بالماء الساخن على ١٠٠درجة مئوية لمدة ٢ دقيقة وإجراء التجفيف علي صواني التجفيف في فرن التجفيف علي ٦٥ درجة مئوية والطحن علي مرحلتين بإستخدام مطحنة للوصول إلي حجم جزيئات صغير ٣٠٠ ميكرون ثم الطحن لتقليل حجم الحبيبات للوصول إلي ١٥٠ : ٢٥٠ ميكرون و`ذللك عن طريق النخل بواسطة منخل أوتوماتيكي هزاز .

٢- تم إجراء مجموعة من المعاملات قبل التجفيف علي شرائح نبات الطرطوفة لتحسين من لون وحجم جزيئات المسحوق الناتج .

تم المعاملة 0.5% بحامض الستريك . مع المعاملة سواء بالبخار الساخن أو السلق على درجة ١٠٠ درجة مئوية ومع الرش بمحلول ميتابيسلفيت الصوديوم -كمصدر ل SO2 - بتركيزات (0.5% -1.5% and 2.0% ١%) لكل لتر ماء.

٣- تم إنتاج مسحوق من درنة الطرطوفة بإستخدام معاملة السلق فى حالة تقشير - وعدم تقشير الدرنات والمقارنة بين تلك المعاملتين ومعرفة الإختلافات فى التركيب الكيمائى والتى كانت فى نسبة الرماد والالياف الزائدة فى حالة عدم التقشير عنه فى حالة التقشير.

أما المظهر الخارجى لشرائح الطرطوفة وكذلك للمسحوق الناتج فكانت الأفضلية للحصول على مسحوق فاتح اللون فى حالة المسحوق الناتج من معاملة عدم التقشير.

٤- كما تم دراسة مدي تأثير التخزين لمدة ثلاثة و ستة أشهر من التخزين علي الخصائص الكميائية لمسحوق الطرطوفة حيث حدث تغير طفيف فى المحتوى الكيمائى خلال هذه الفترة .

٥- وكذلك تم دراسة علي إمكانية تقليل التكتل -الناتج عن تواجد سكر الأنيولين بنسبة كبيرة فى مسحوق الطرطوفة - وذلك عن طريق إضافة دقيق القمح بنسب ٥%، ١٠%، ٢٠%، ٣٠%، ٤٠%، ٥٠%.، وقد تبين التأثير الأيجابى على هذه الظاهرة مع إرتفاع نسبة الإضافة حتى ٥٠ %.