J. Agric. Sci. Mansoura Univ., 32 (8): 6521 - 6530, 2007

A NEW TOOL BY SOLAR DRYING IN PREPARING INSTANT *FALAFEL*

Ziena, H. M. S.
Food Science & Technology Dept. , Fac.of Agric.(Damanhour), Alex. Univ.

ABSTRACT

Instant *falafel* samples were prepared and dried by a solar dryer, designed recently at Faculty of Agriculture (Damanhour) , Alexandria University for drying some fruits and vegetables , and compared with that prepared by hot – air drying , freezing (- 40 ^{o} C) and fresh (control) samples . The time required for solar drying such *falafel* pastes was 3 days (during June 2005) . The resultant instant *falafel* samples were rehydrated or thawed , fried and subjected to sensory evaluation . Proximate chemical composition and microbiological evaluation of the instant *falafel* were also estimated . The moisture contents were determined at 4 hr intervals until the *falafel* pastes were solar dried . Solar drying equation , drying constant (K) and coefficient of determinations (R^2) were also computed to predict the time required for solar drying such *falafel* pastes under these conditions and to predict the moisture content at any time of solar drying as well .

Data revealed the possibility of using such solar dryer to dry pastes and prepare instant *falafel* with high quality closed to that prepared by hot – air drying .

Keywords: *Falafel, instant, solar drying, organoleptic properties, chemical composition , microbiological evaluation , solar drying equation .*

INTRODUCTION

Faba bean are mainly eaten in Middle East countries as a cheap source of dietary protein . In Egypt , it is used to prepare many popular dishes that are consumed by a majority of the population (Youssef *et al* , 1988) . In this respect, *Falafel* (named also *Taemya*) is considered as one of the most important staple foods. The main constituent of *Falafel* is faba bean (*Vicia faba* L.) with variable amounts of onion, garlic and some vegetables . The whole mixture is finely ground prior to forming into patties which are finally deep fried in oil (Ziena *et al*., 1988) .

A great deal of attention has been paid towards the instantization and agglomeration of foods. In Egypt, instant *Falafel* is one of the most marketable instant foods .

To prepare instant *Falafe*l of super quality, the paste should be prepared by applying all common pretreatments (dehulling, soaking, mincing,..etc.) applied in fresh *Falafel* processing and finally dehydration is conducted . It was clear that such a procedure is not that used to produce the instant *falafel* marketed in Egypt since commercial instant *falafel* is prepared by just mixing the dry raw ingredients without any technological pretreatments, the method which was found to be inconvenient to produce instant *falafel* of high quality (Ziena *et al*. ,1992) .

Solar dryer as a clean and a cheap tool for drying fruits and vegetables has been designed and adopted at Faculty of Agriculture (Damanhour), Alexandria University (Abdel- Ghaffar *et al*, 2006). Information about the performance of such solar dryer for drying food pastes e.g. *Falafel* paste are scarce and didn't carryout yet. So, the present study was carried out to evaluate the performance of such solar dryer for drying

Falafel paste and to study the quality of the resultant instant *Falafel* comparing with that dried by hot air or that kept frozen .

MATERIALS AND METHODS

Materials

Green faba bean pods , dry decorticated faba beans (cotyledons) , balady bread , garlic , onion , parsley , leek , coriander , salt and spices were purchased (during April – June, 2005) from the local market at Alexandria , Egypt .

Methods :

The methods adapted for *Falafel* preparations are those used in Egyptian homes and by *Falafel* processors (Fig 1) . housewives used to prepare *falafel* from green beans in contrary to *Falafel* processors who use dry faba bean cotyledons . Different *Falafel* recipes are prepared from ingredients as shown in Table (1) . Green faba bean seeds were kept frozen at – 40 ^{o}C until needed, thawed and decorticated manually . Dehydration process of *Falafel* paste by hot air was conducted at 55 ^{o}C using a circular hot air dryer (Kestner Evaporator & Engineering Co. Ltd., Green hithe, Kent , Great Britain) according to Ziena *et al,* (1992) . An indirect solar dryer that designed recently to dry some fruits and vegetables by Abd-El Ghaffar *et al.* (2006) at Faculty of Agriculture (Damanhour) , Alexandria University was used for solar drying of *Falafel* pastes .

Organoleptic properties.

Different fried *Falafel* samples understudy were presented simultaneously to a panel of 10 panelists. The panelists were asked to rank each sample on the hedonic scale of 1 (very poor); 2-4(poor); 5-6 (fair); 7-8 (good); and 9-10(excellent) for each of colour, flavour, texture and overall acceptability.(Moskowitz, ,1974).

Table 1 : The main ingredients of *Falafel* paste samples .

Formula No	Minced Green Bean (g)	Minced Soaked Cotyledons (g)	Bread (g)	Vegetable Mix.* (g)	Red Pepper (g)	Black Pepper (g)	Dried Coriander (g)	Salt (g)
1	600	-	90	120	3	6	3	30
2	480	120	90	120	3	6	3	30
3	360	240	90	120	3	6	3	30
4	240	360	90	120	3	6	3	30
5	120	480	90	120	3	6	3	30
6	-	600	90	120	3	6	3	30

*** Vegetable mix. contained onion , garlic , parsley and Egyptian leek**

Analytical Methods

Different *Falafel* samples were analyzed by the standard method of AOAC(1995) for moisture , crude protein (N X 5.85), crude fat, total ash and crude fiber . N-free extract was calculated by difference .

Microbiological Evaluation

Samples were taken and prepared under aseptic conditions . The necessary dilutions were made and the pouring plate technique was followed . The count of mesophilic aerobic bacteria on nutrient agar medium (N. A.) and yeast and mould on sabouraud dextrose agar medium (S. D. A.) were determined according to Difico's Manual (1984) .

F1

Mathematical Analysis

The predicted equations of solar drying for *Falafel* pastes , the drying constant (K) and the coefficient of determination (R^2) were computed according to Abdel- Ghaffar *et al* (2006) .

Statistical Analysis:

Data were analyzed using analysis of variance of the SAS package (SAS,1985) .

RESULTS AND DISCUSSION

Data presented in Table (2) show the sensory evaluation of different *Falafel* samples, Results revealed that all samples were accepted concerning the sensory evaluation .

Table 2 :Sensory evaluation of different *Falafel* samples* .

Sample& No.	Formula	Color	Flavor	Texture	Overall acceptability
Fresh	1	7.0^{e}	٨.0^{abc}	7.2^{ef}	7.3^{de}
	2	7.2^{de}	8.0^{abc}	7.2^{ef}	7.3^{de}
	3	7.5^{cd}	8.2^{ab}	7.5^{de}	7.8^{bc}
	4	7.9^{abc}	8.1^{ab}	7.8^{cd}	8.0^{ab}
	5	8.2^{ab}	8.4^{a}	8.3^{a}	8.3^{a}
	6	8.5^{a}	8.3^{a}	8.2^{ab}	8.2^{a}
Solar drying	1	6.5^{g}	7.5^{de}	7.0^{f}	7.0^{fg}
	2	6.7^{fg}	7.7^{cd}	7.0^{f}	7.0^{fg}
	3	7.1^{def}	7.9^{bc}	7.3^{e}	7.5^{cd}
	4	7.8^{bc}	7.8^{bc}	7.5^{de}	7.8^{bc}
	5	7.9^{abc}	8.0^{abc}	7.9^{bc}	8.0^{ab}
	6	8.2^{ab}	8.2^{ab}	8.3^{a}	8.2^{a}
Hot air drying	1	6.7^{fg}	7.3^{e}	6.8^{g}	6.9^{g}
	2	6.9^{ef}	7.5^{de}	6.7^{g}	6.8^{g}
	3	7.3^{de}	7.7^{cd}	7.0^{f}	7.2^{ef}
	4	7.8^{bc}	7.7^{cd}	7.2^{ef}	7.6^{cd}
	5	8.0^{ab}	7.7^{cd}	7.6^{cd}	7.7^{c}
	6	8.3^{ab}	7.8^{bc}	7.9^{bc}	8.8^{ab}
Freezing	1	6.4^{g}	7.5^{de}	6.7^{g}	6.7^{g}
	2	6.6^{fg}	7.5^{de}	6.9^{fg}	6.9^{g}
	3	6.9^{ef}	7.9^{bc}	6.9^{fg}	6.9^{g}
	4	7.4^{cd}	7.8^{bc}	7.2^{ef}	7.4^{de}
	5	7.8^{bc}	8.1^{ab}	7.7^{cd}	7.8^{bc}
	6	8.0^{abc}	8.0^{abc}	7.9^{bc}	8.0^{ab}

*** Means in a column not sharing the same superscript are significantly different at P ≤ 0.05 .**

However, differences mainly between different recipes were significantly high in contrary with that between different treatments (i.e. solar drying , hot air drying and freezing) . In other words, decreasing the addition of green cotyledons or increasing the addition of soaked dry cotyledons resulted in increasing of the acceptability . It was obvious that panelists ranked *Falafel* samples No. 5 & 6 as significantly superior to the rest samples which reflect the possibility to add up to 20 % green cotyledons .

Notwithstanding , the colour of fried *Falafel* followed by the texture were affected extremely (more darker in colour and compact in texture) by increasing the quantity of green cotyledons in the product .

It was also clear that the flavour of fresh *Falafel* (control) was the superior followed by frozen *Falafel* . than dried samples by the two methods .this may be due to drying process may resulted in loss some volatile matters (aroma).

Data presented in Table (3) reveal that although solar drier success in drying *Falafel* paste to a suitable level , the moisture contents in resultant *Falafel* were significantly higher than their counterpart dried by hot air .

Table 3 : Proximate chemical composition of different *Falafel* samples (% , on dry weight basis) .

Sample & Formula No.	Moisture	Crude protein*	Crude ether extract	Ash	Crude fiber	N – free extract
Solar drying						
1	7.77^{d**}	23.13^{e}	1.77^{cd}	4.11^{a}	6.70^{a}	64.29
2	7.80^{d}	23.30^{de}	1.75^{d}	4.16^{a}	6.82^{a}	63.97
3	7.84^{d}	23.67^{cd}	1.78^{c}	4.23^{a}	6.55^{a}	63.77
4	7.22^{d}	24.08^{bc}	1.88^{ab}	4.19^{a}	6.75^{a}	63.10
5	7.30^{d}	24.36^{bc}	1.80^{bc}	4.14^{a}	6.46^{a}	63.24
6	7.13^{d}	24.77^{a}	1.92^{a}	4.33^{a}	6.78^{a}	62.20
Hot air drying						
1	4.86^{e}	23.18^{e}	1.73^{d}	4.08^{a}	6.77^{a}	64.24
2	5.03^{e}	23.36^{de}	1.78^{cd}	4.19^{a}	6.69^{a}	63.98
3	4.84^{e}	23.76^{cd}	1.90^{ab}	4.15^{a}	6.60^{a}	63.59
4	4.91^{e}	24.17^{bc}	1.82^{bc}	4.11^{a}	6.88^{a}	63.02
5	4.68^{e}	24.50^{ab}	1.88^{b}	4.29^{a}	6.52^{a}	62.81
6	4.77^{e}	24.85^{a}	1.95^{a}	4.23^{a}	6.72^{a}	62.25
Freezing						
1	60.21^{a}	23.08^{e}	1.82^{bc}	4.14^{a}	6.58^{a}	64.38
2	59.07^{a}	23.32^{de}	1.77^{cd}	4.10^{a}	6.66^{a}	64.15
3	58.50^{a}	23.76^{cd}	1.83^{bc}	4.28^{a}	6.52^{a}	62.88
4	55.01^{b}	24.23^{bc}	1.87^{b}	4.12^{a}	6.80^{a}	62.98
5	53.20^{b}	24.42^{ab}	1.95^{a}	4.18^{a}	6.55^{a}	62.90
6	50.55^{c}	24.95^{a}	1.90^{ab}	4.29^{a}	6.82^{a}	62.04

*** N x 5.85**

**** Means in a column not sharing the same superscript are significantly different at P ≤ 0.05 .**

It was clear that noticeable increases in crude protein and crude ether extract contents were traced when the portion of soaked dry cotyledons increase at compared to their counterpart green cotyledons . These differences can be explained on the basis that accumulation of such components takes place with seed maturation (Ziena *et al,* 1987) . However, ash and crude fiber contents showed another figures since they seemed to be more or less the same in all *Falafel* samples .

The method of preparation (i.e. drying by the two methods or freezing) didn't affect the proximate chemical composition except moisture content . The chemical composition of all instant *Falafel* samples understudy agree with that reported by Youssef *et al* (1987) .

Data presented in Table (4) show the microbial changes that took place when fresh *Falafel* pastes were dried by both hot air and solar heating or after kept frozen for 72 hr . Each of total counts of mesophilic aerobic bacteria , and yeasts and molds decreased significantly as affected by freezing or drying *Falafel* pastes by the two methods .

It was clear that using the two drying methods , that showed the same trends of decline , had more pronounced effect on the reduction of both the count of bacteria and yeasts and molds than freezing did .The significant decline may be due to the reduction of water activity through drying . Moreover , the solar dryer applied in the present study controlled the microbial counts due to the short time of solar drying (up to 3 days) and / or the drying conditions in this system is controlled to some extent . The

lower count of bacteria for the samples dried by solar drying and hot air could be attributed to the highest temperature applied by the two methods as explained by Whitfield (2000) who reported that temperature ranging between 37 ^{O}C to 71.2 ^{O} C was found to effectively kill bacteria . The low moisture countents , as found by Scalin (1997) who reported that reducing the moisture count of food to the range between 10 % and 20 % resulted in preventing food from yeast and mould contaminations . Notwithstanding , it well known that natural fermentation of *Falafel* paste during preparation and at the first period of drying in which lactic acid bacteria play an important role provides an inexpensive method by which people can obtain good quality protein , reduce the flatulence which resulted from legumes consumption and improve the flavour (El-Sahn and Youssef , 1989) .

Abdel Ghaffar *et al* (2006) mentioned that fruits and vegetables dried by sun-drying had the highest counts of bacteria and yeast and molds when compared to solar drying and hot-air drying .

Table 4 : Microbiological evaluation of different *Falafel* samples* .

Sample & Formula No.		Bacteria (C.F.U / g)	Yeasts & Molds (C.F.U / g)
Fresh	1	3.3×10^{6a}	5.5×10^{2a}
	2	3.0×10^{6a}	4.2×10^{2ab}
	3	2.7×10^{6a}	7.8×10^{2a}
	4	3.1×10^{6a}	6.2×10^{2a}
	5	5.5×10^{6a}	5.9×10^{2a}
	6	5.2×10^{6a}	7.2×10^{2a}
Solar drying	1	2.3×10^{3c}	2.0×10^{2cd}
	2	2.1×10^{3c}	2.1×10^{2cd}
	3	2.5×10^{3c}	1.8×10^{2d}
	4	2.9×10^{3c}	2.4×10^{2cd}
	5	2.7×10^{3c}	1.7×10^{2d}
	6	2.2×10^{3c}	1.6×10^{2d}
Hot-air drying	1	1.9×10^{3c}	1.4×10^{2d}
	2	2.1×10^{3c}	1.6×10^{2d}
	3	2.3×10^{3c}	1.9×10^{2d}
	4	2.0×10^{3c}	2.0×10^{2cd}
	5	1.9×10^{3c}	1.2×10^{2d}
	6	2.3×10^{3c}	1.3×10^{2d}
Freezing	1	7.7×10^{5b}	2.7×10^{2bc}
	2	6.5×10^{5b}	3.6×10^{2b}
	3	8.1×10^{5b}	3.5×10^{2b}
	4	6.3×10^{5b}	4.7×10^{2ab}
	5	5.1×10^{5b}	2.3×10^{2c}
	6	4.7×10^{5b}	2.5×10^{2c}

*** Means in a column not sharing the same superscript are significantly different at P ≤ 0.05 .**

Moisture contents of different *Falafel* preparations during solar drying are presented in Table (5).The moisture content in the fresh *Falafel* pastes at the beginning of solar drying varied significantly . Increasing green cotyledons in the *Falafel* preparation resulted in a paste with relatively higher moisture content in contrary to soaked dry cotyledons .

It was clear that all *Falafel* pastes loss their moisture gradually during solar drying. The decline in moisture contents within the same *Falafel* sample were significant .

Table 5 : Moisture contents of different *Falafel* samples during solar drying* .

Solar time	*Falafel* Formula No.					
	1	2	3	4	5	6
1st day						
8 am	$^{a}60.92^{a}$	$^{a}59.68^{a}$	$^{ab}58.85^{a}$	$^{bc}55.39^{a}$	$^{cd}53.76^{a}$	$^{d}50.91^{a}$
12	$^{a}54.18^{b}$	$^{a}53.75^{b}$	$^{ab}52.61^{b}$	$^{bc}50.44^{b}$	$^{cd}49.06^{b}$	$^{d}46.28^{b}$
4 pm	$^{a}50.20^{c}$	$^{a}48.23^{c}$	$^{a}48.05^{c}$	$^{b}44.80^{c}$	$^{bc}42.65^{c}$	$^{c}40.33^{c}$
8	$^{a}44.38^{d}$	$^{ab}42.49^{d}$	$^{ab}42.15^{d}$	$^{bc}40.07^{d}$	$^{bc}38.16^{d}$	$^{d}35.05^{d}$
2nd day 8 am	$^{a}40.14^{e}$	$^{ab}37.76^{e}$	$^{ab}37.03^{e}$	$^{bc}35.26^{e}$	$^{c}34.07^{e}$	$^{d}30.66^{e}$
12	$^{a}33.61^{f}$	$^{ab}31.30^{f}$	$^{ab}31.88^{f}$	$^{ab}30.75^{f}$	$^{b}29.68^{f}$	$^{c}25.70^{f}$
4 pm	$^{a}28.75^{g}$	$^{ab}26.57^{g}$	$^{ab}27.16^{g}$	$^{bc}24.63^{g}$	$^{c}22.76^{g}$	$^{d}19.53^{g}$
8	$^{a}22.87^{h}$	$^{bc}18.11^{h}$	$^{ab}19.75^{h}$	$^{bc}18.05^{h}$	$^{c}16.37^{h}$	$^{c}15.71^{h}$
3rd day						
8 am	$^{a}16.17^{i}$	$^{ab}15.66^{i}$	$^{a}16.43^{i}$	$^{ab}14.28^{i}$	$^{ab}13.35^{i}$	$^{b}12.68^{i}$
12	$^{a}13.13^{j}$	$^{ab}12.30^{j}$	$^{ab}12.86^{j}$	$^{ab}11.34^{j}$	$^{ab}11.04^{j}$	$^{b}10.31^{j}$
4 pm	$^{a}10.40^{k}$	$^{a}10.05^{k}$	$^{a}9.90^{k}$	$^{a}9.56^{k}$	$^{a}9.26^{k}$	$^{a}8.77^{k}$
8	$^{a}7.77^{l}$	$^{a}7.80^{l}$	$^{a}7.84^{l}$	$^{a}7.22^{l}$	$^{a}7.30^{l}$	$^{a}7.13^{l}$

*** Means not sharing the same superscript are significantly different at P ≤ 0.05 (right letters , in a column , are between times of solar drying within the same sample ; while left letters , in a raw , are between different samples at a given time of solar drying) .**

However , the moisture contents of different *Falafel* pastes that varied significantly and ranged between 50.91 and 60.92% at the beginning of solar drying reached 7.13 – 7.84 % at the end of solar drying .Notwithstanding , no significant difference was achieved between the moisture contents in all *Falafel* preparation during the third day of solar drying till the end of such experiment .

Mathematical Analysis

Values of corrected moisture ratios MR* = (M / Mo) for different *Falafel* pastes during solar drying with their corresponding drying time are given in Figures (2) and (3) where M is the moisture content at anytime while Mo is the initial moisture content . They were used to obtain the drying constant (K) and predicated equation of drying time . The suitable form of this equation that fits the design of such solar dryer understudy as obtained by Abd- El-Ghaffar *et al* (2006) is :

$$MR^{*} = M / Mo = e^{-Kt}$$

where :

K : the drying constant

t : the drying time (hr)

The coefficient of determination (R^{2}) was the primary criterion for selecting the best equation to describe the solar drying curves . It was clear from Figures (2) and (3) that the drying constant K , which indicates the drying rate , varied considerably depending on the natural of the food material e.g the types and ratios of ingredients . It is also useful to apply such equations resulted in the present study to predict the solar time required to

dry the pastes under the same conditions as well as to predict the moisture content at a given time during solar drying process .

Fig. 2: Corrected moisture ratio MR*,versus accumulated solar drying time (hr) for drying falafel paste
A (Formula 1) , B (Formula 2) , C (Formula 3)
for ▬▪▬ experimental and ▬▬▬ predicted moisture ratios .

Fig. 3: Corrected moisture ratio MR*,versus accumulated solar drying time (hr) for drying falafel paste
D (Formula 4) ,E (Formula 5) , F (Formula 6)
for ▬■▬ experimental and ▬▬▬ predicted moisture ratios

Conclusion :

Falafel paste can be successfully solar dried to produce instant *Falafel* has a good quality in terms of organoleptic properties , chemical composition and microbiological evaluation .

REFFERENCES

Abd El-Ghaffar , S.S. ; Ziena ,H.M. S.; Youssef , M.M. and Shokr ,A.Z. (2006). Quality attributes of some fruits and vegetables crops preserved by three diierent drying methods . Alex. J.Fd. Sci. &Technol., 3 : 31- 41 .

AOAC(1995).Official Methods of Analysis of the Association of Official Analytical Chemist,. 16thEd., Vol Π. the Association of Official Analytical Chemist Inc ,Arlington . Virginia 22209 , USA.

Difico's Manual (1984) . Manual of Dehydrated Culture and Reagents for Microbiology . Detroit, Michigan, USA .

El-Sahn ,M.A and Youssef, M.M. (1989) . Microbial changes during the natural fermentation of *falafel* paste .Microbiologie – Aliments – Nutriation 7 : 267-272

Moskowitz, H. A. (1974) . Sensory evaluation by magnitude estimation .J. Food Technol. , 28 : 16 – 22 .

SAS (1985). User's guide statistics .Version 5, Cary, NC, USA; SAS Inst .

Scalin , D. (1997) . The design , construction and use of an indirect , through – pass , solar food dryer . Home Power Magazine . Issue No. 57 , Feb. / March .

Whitifield , D.E. (2000) . Solar Drying International Conference on Solar cooking , Kimberly South Africa 26 th - 29 th November , 2000 .

Youssef , M.M. ; Abdel – Aal , M.H. , Hamza , M.A. and El- Banna , A.A. (1987) . Chemical composition of some Egyptian foods made from faba beans (Vicia faba L.) .Die Nahrung , 31 : 185 – 187 .

Youssef , M.M. ;Ziena , H.M. & Abdel – Nabey ,A.A. (1988) .Acceptaility and trypsin inhibitor of falafel as affected by particle size and roasting of faba bean cotyledons . Alex .J. Agric .Res. 33 : 121-133 .

Ziena ,H.M. ; Abdel Aal, M.H. and Youssef ,M.M. (1988) . Formulation and characteristics of new recipes of Egyptian patti bean (*Falafel*).Plant Foods For Human Nutrition , 38 : 225 - 234 .

Ziena, H.M.S. ; Shehata, A.M. El-Tabey ; Youssef, M.M. and Abd El-Bary, A.A. (1987) . Chemical changes during the development of faba beans (Vicia faba L.) as affected by pod and seed positions . Egyptian J. of Food Sci., 15: 147-160.

Ziena ,H.M.; Youssef ,M.M. and Hamza ,M.A. (1992). Effect of the method of processing on quality of instant Falafel .2nd Alex Cont. Fd. Sci & Technol. ,150-163 .

وسيلة جديدة بالتجفيف الشمسى لإعداد فلافل سريعة التحضير

حامد مرسى سعد زينة

قسم علوم وتكنولوجيا الأغذية – كلية الزراعة بدمنهور – جامعة الإسكندرية - دمنهور

تم إعداد وتجفيف فلافل سريعة التحضير بإستخدام المجفف الشمسى الذى صمم حديثاً لتجفيف بعض الفاكهة والخضروات بكلية الزراعة بدمنهور – جامعة الإسكندرية حيث إستغرقت عملية التجفيف بالمجفف الشمسى ثلاثة أيام (خلال يونيو ٢٠٠٥) هذا وقد تمت مقارنة الفلافل سريعة التحضير الناتجة بتلك المجففة بالهواء الساخن أو المجمدة على – ٤٠ ° م أو الطازجة (كونترول) حيث أعيد تبليل الفلافل المجففة أو تفكيك الفلافل المجمدة ثم القلى وتقييم الفلافل المقلية حسياً . كما تم تقدير التركيب الكيماوى التقريبى والتقييم الميكروبيولوجى للفلافل سريعة التحضير . كما تم تقدير المحتوى الرطوبى لعجائن الفلافل أثناء التجفيف بالطاقة الشمسية وذلك كل ٤ ساعات وحتى الجفاف حيث حسب آلياً كلا من معادلات التجفيف الشمسى ، ثابت التجفيف الشمسى ، معامل التقدير وذلك للتنبؤ بالزمن اللازم لتجفيف عجينة الفلافل تحت ظروف هذا المجفف الشمسى والتنبؤ بالمحتوى الرطوبى عند أى زمن تجفيف .

هذا وقد أوضحت النتائج إمكانية إستخدام هذا المجفف الشمسى لتجفيف العجائن وإعداد فلافل سريعة التحضير ذات جودة عالية ومطابقة لتلك الناتجة بالتجفيف بالهواء الساخن وذلك من حيث الخواص العضوية الحسية ، التركيب الكيماوى ، التقييم الميكروبيولوجى .