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EXPERIMENTAL STUDY OF THE USE OF CELLULAR EM ENERGY IN ENSURING THE CHEMICAL AND MICROBIOLOGICAL SAFETY OF GRAIN, FLOUR, AND BREAD PRODUCTS PRODUCED AND STORAGED IN UZBEKISTAN

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Abstract. In this work, the mathematical basis of the use of UYUCH EMM energy in ensuring the chemical and microbiological safety of grain, flour and bread products, the disinsection of wheat grain insects and the disinfection of harmful microflora of flour and bread with the help of UYUCH EMM, the experimental construction, methodology and the obtained results are presented. In particular, a special UV experimental stand was built for disinfestation of stored wheat grains, and at different UV energies, the condition of the following insects found in wheat grain warehouses: mill and barn moth, grain moth, weevils and flour mites, and mealybugs was monitored and the percentage of their death was determined. At the same time, based on electrophysical laws, the dependence of the minimum energy for killing insects on the relative radiation power and field strength of the bioobject and the power and frequency of the UV electromagnetic field, and the dielectric conductivity of the insects was shown. Also, the mineral composition, mycotoxins and toxic elements of wheat grain, flour and Uzbek national bread "Obi-non" grown in Samarkand and Surkhandarya regions, were determined on a polarography experimental stand. According to the chromatogram obtained for minerals of Uzbek national bread "Obi-non", it was confirmed that it contains seven main mineral elements, among which the most important for the human body are potassium, calcium, copper, and lead, and their content is at the required level, their normal content in bread products ensures food safety for human life. The chromatogram of the first-grade wheat flour produced at the Surkhandarya Products Enterprise for toxic elements: cadmium, arsenic, lead, mercury, lead and copper, mycotoxins and iron was obtained, and their content is at the required level.

Keywords: grain, flour, bakery products, chemical and microbiological safety, energy of the uyuch emm

1. Introduction. Currently, in the world, due to environmental changes, difficult weather conditions, uneven operation of industrial enterprises, and the use of chemical preparations in agriculture, various additives are found in the composition of food consumed, reducing its safety. The quality of grain, flour, and bread determines the level of provision of the population with the main food product and, as a result, the economic and political stability of the state. Therefore, it

is important to purposefully change the technological and physicochemical properties of agricultural raw materials, optimize the parameters of processing and storage processes.

In the world, due to the deterioration of grain quality, its technological indicators, loss of dry matter, contamination with highly toxic and carcinogenic metabolic products of microscopic fungi - mycotoxins, and damage to grain by fungal microorganisms and bacteria, important research is being conducted on the preparation of raw materials used in technological processes in the system of measures aimed at obtaining new quality food products. In this regard, special attention is paid to the disinfection of grain before sending it for further processing or storage, the production of ecologically clean bread products, and the addition of various special chemical additives to the dough.

In our republic, extensive scientific research is being carried out to increase the nutritional safety of bakery products made from high-grade flours obtained from local wheat varieties, and to microbiologically process bakery products using various devices. The Development Strategy of New Uzbekistan for 2022-2026 specifically identifies the issues of "Priority areas of economic development and further intensification of the production of high-value-added finished products based on deep processing of local raw materials, and the development of qualitatively new types of products and technologies." In this regard, it is of particular importance to control the chemical and microbiological hazards of bread and bakery products in mass consumption, their raw materials, conduct experimental studies on disinfestation of wheat grain and disinfection of harmful microflora of flour and bread.

Currently, 18-20% of the total industrial production in Uzbekistan is the production of food products, and taking into account that the main part of it falls on bakery products, and this averages up to 920 thousand tons per year, ensuring food safety by preventing toxicological poisoning in their composition is an important task. The results of studies conducted by Russian researchers [1, 2] showed that in the post-harvest period, grain crops arriving at storage facilities and processing plants are contaminated with intestinal microorganisms and form molds with highly toxic metabolites during the post-harvest period at the bacterial milling and bread production stages, which cause self-heating, bread potato disease and contamination of products, resulting in average grain losses of 20-30%, flour - 10-15% and bread - 25-30% [3]. Therefore, studies aimed at their destruction with the help of UHF electromagnetic energy and reducing total losses are considered urgent.

Decree of the President of the Republic of Uzbekistan dated January 28, 2022 No. PF-60 "On the Development Strategy of New Uzbekistan for 2022-2026", Decree of January 12, 2018 No. PF-24 "On measures to create effective mechanisms for the implementation of scientific and innovative developments and technologies in production", Decree of October 30, 2020 No. PF-6097 "On approval of the Concept of the Development of Science until 2030", Decree of October 24, 2019 No. PF-5853 "On approval of the Strategy for the Development of Agriculture of the Republic of Uzbekistan for 2020-2030", Decree of April 26, 2018 This article will to a certain extent serve the implementation of the tasks set forth in Decrees and Resolutions No. PQ-3680 "On Measures to Further Ensure the Food Security of the Country" and other regulatory legal acts related to this activity.

2. Materials and Methods. In determining the chemical and microbiological safety of grain, flour and bread products, the general standard: colorimeter, chromatography, polarimetry, KMAFAM bacteria (BGKP, GOST 50474-93), the total number of bacteria in 1 gram of the product in 1 ml is calculated as: M = N / m • C, where: N - degree of mixing of the sample; m - amount of inoculum placed in a Petri dish, cm3; C - average number of colonies determined. Microbial culture and other methods [4, 5] were used to determine the chemical safety of wheat grain, flour and bread using the polarigraphy experimental stand and the method of

determination of chemical mycotoxins and toxic elements, which was carried out in the Surkhandarya Sanitary and Epidemiological Center (Fig. 1).

The studies were carried out using a laboratory polarograph AVS 1.1 (Russian company "Volta") voltammetric analyzer with a detector of Cu Pb Cd Zn Bi Ni Ag I As Fe Mn Sb. The ABC-1.1 is designed to work as part of a complex consisting of a voltammetric analyzer and a personal computer (international operating system: Win95). The device is connected to the computer via the COM1-COM4 serial port (the port is selected by the program). The measurement results of the device are controlled and processed by the program supplied with the device via a computer (touch monitor).

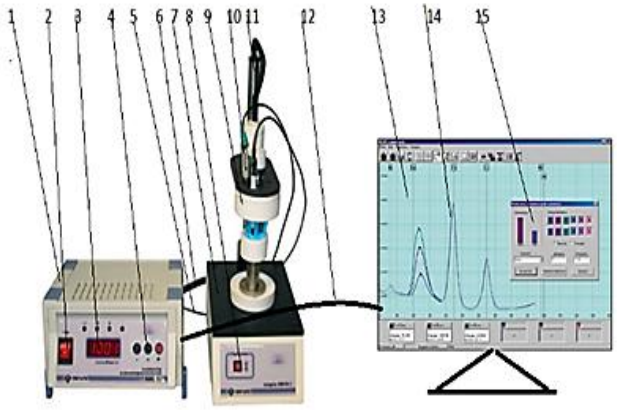

Figure 1. Experimental stand of the polarograph AVS 1.1.- voltammetric analyzer.

1. Analyzer; 2. Switch;
3. Recorder; 4. Signal lamps; 5. Power cable; 6. Cable connecting the analyzer to the mixer; 7. Electrode mixer; 8. Mixer electric motor ignition; 9. Sample container; 10. Electrodes; 11. Tripod;
12. Computer connection cable; 13. Computer monitor with processor; 14. Polarograms; 15. Monitor sensor

$I_d = k_M s_M$.

In this case, the current strength in the system depends on the diffusion rate of the process, which in turn depends on the difference in concentrations in the solution mass, that is, on the difference in the concentration of S0M and SM of the electrode layer, which can be written using the Ilkovich formula in the following form:

$I = k_M(c_M^0 - c_M)$

used in the processing of experimental results. In accordance with the purpose, it should be noted that when processing the experimental results, the amount of toxins obtained is increased by 25% when calculated according to the Ilkovich formula, since the error of the ABS-1.1 polarograph is indicated in this case by 10 -20%, therefore, a 5% margin is added, and all the obtained results are protected in advance[7].

Based on electrophysical laws[8], if at time t the relative radiation power P∧ , W/m3, which is spent on heating the biological object Δt, and the field strength E, V/m; can be determined. The results of the obtained mathematical calculations show that: the approximate characteristics of the biological object: m=10-15 kg; C_{ob}=4190 J/kg^{0}C; If $\sigma_{об}=(5\cdot10^{-5}42\cdot10^{-4})$ cm/j (at high frequencies), then if we heat it in an electromagnetic field with a frequency of f=$3\cdot10^9$ Hz for τ-60 seconds, the object will heat up, and the relative field strength consumed will be P_s=300 μW/cm2. , which can be taken as the minimum energy for the reproduction of microorganisms. Also, the death rate of microorganisms depends on its power and frequency, how large and small the number of microorganisms is [9]. In general, the survival of microorganisms in products depends on the ratio of the concentration of microorganisms to the ratio of a_ε, and if $a_\varepsilon<1$, a decrease in the concentration of Cυ increases the death rate of microorganisms, and if $a_\varepsilon>1$ and Cυ decreases, then their reproduction rate decreases. If, the FIK (useful efficiency coefficient) of UYuCh EMM energy is 65-70%. Therefore, this method has a higher efficiency than the traditional method (FIK 45-55%)[10].

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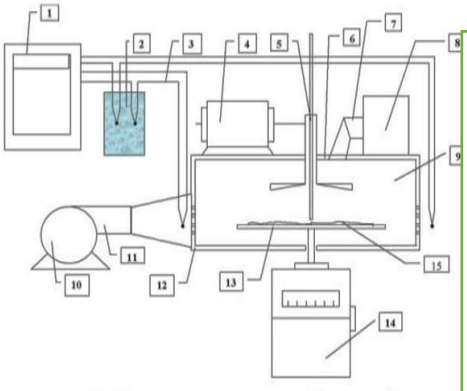
In order to confirm the conclusions obtained from this study, a computerized experimental device (equipment) was created for grain disinsection and disinfection of flour and bakery products (Fig. 2).



1 self-writing KSP -4M; 2- Dewar capacity; 3-temperature sensor (thermocouple - XK); 4-electric motor; 5-thermometer; 6th dissector; 7-wave transmitter 8-O'YuCh-generator-magnetron; 9- resonator drying chamber; 10th fan; 11-calorifer; 12th air inlet; 13-scale base 14-electronic scale VLK-500; 14th research product.

Figure 2. UYUCh- scheme of the experimental device

Grain disinsection method. In the disinsection of grains stored in warehouses, in order to kill harmful insects, samples of grains damaged by the device weighing 100-200 gr. are placed on the base of the chamber in polyethylene bags. Then, after setting the duration of the UYUCh EMM effect on the thermometer, timer, stable air velocity in the chamber, etc., the oven is turned on, while the air parameter in the chamber is constantly maintained (w = 0.01-0.3 m⁄s; T_= 70-800C). The supply of microwave energy with a certain power is carried out in a pulse mode (with ignition) every 2-1 minute until the specified temperature inside the material is reached for 2-4 seconds. Thus, it is continued until the insects die. The experiment was conducted at different microwave power levels: 0.25; 0.50; 1.0 kW., after each experiment, the condition of insects is monitored and the percentage of deaths is determined. The results obtained are entered into the table.

Methodology for disinfection of flour and bread. When disinfecting flour produced from grain and bread from this flour (stored for a while), the same method is used for disinfestation of grains, only here the killing of various microorganisms and bacteria is monitored and determined, not the killing of insects. In this case, of course, the microflora of flour and bread samples must be clear. Also, a sample of bread is cut from its soft layer and an experiment is conducted.

In order to know the shelf life of bread, its storage under the influence of UYUCHEMM energy for 36 hours, several days and several months after baking and the killing of microbes in it, the condition of the bread is monitored.

The percentage of killing of microorganisms, the absence of division are determined in all cases by the standard method "Sowing". All experimental results are included in the tables.

3. Results. Based on the method of disinfestation of grains collected from warehouses, the state of insects in wheat grain warehouses was monitored and the percentage of their death was determined using microwave energy at a power of: 0.25; 0.50; 1.0 kW. The results are given in Table 1.

Table 1

Disinsection of wheat granaries with UYUCH against insects.

№ п/н	The name of insects	UYuCh-disinsection. Rsvch, kW; time sec.											
		0,14			0,25			0,36			0,45		
		10	20	30	10	20	30	10	20	30	10	20	30
1	Mill furnace	+	+	-	+	-	-	-	-	-	-	-	-
2	Warehouse fireplace	+	+	-	+	-	-	-	-	-	-	-	-
3	Grain moth	+	+	-	+	-	-	-	-	-	-	-	-

4	Unegichs	+	+	+	+	+	-	+	+	-	+	-	-
5	flour kleschchi	+	+	+	+	+	+	+	+	-	+	-	-
6	Khrushak	+	+	+	+	+	+	+	-	-	+	-	-

Note: + - not completely dead; - completely dead.

The results of visual observation in the disinsection with microwave CELL showed that: mill moth, barn moth and grain moth were killed at R = 0.25 kW for 20-30 s., and the rest were killed at R = 0.36 kW for 30 seconds. If we increase the power to R = 0.45 kW and increase the time to 20 seconds, they can be completely killed. Among the insects, the most resistant are the beetles and the beetles, which remain in a state of stupor without dying at relatively low power and time.

In order to study the mineral composition (mg/100 g) of wheat flour of the first grade and the Uzbek national bread “Obi-non”, [11] the mineral composition of the flour was obtained and the chromatogram of the Uzbek national bread “Obi-non” for the minerals presented was compared in Table 2.

Table 2

Mineral composition of 1st grade wheat flour and "Obi-non" (in mg/100 g of product)

№	Mineral substances	1 grade wheat flour	"Obi-non" Uzbek national bread
1	P	121.08-0.03	141.34
2	K	227.14-0.05	268.87
3	Ca	49.93-0.04	69.59
4	Mg	1.09-0.08	1.20
5	Fe	2.19-0.06	2.43
6	Cu	0.41-0.04	0.39
7	Zn	1.72-0.02	1.83

The results presented in the table show that it contains seven main mineral elements. Among them, K and Ca, which are considered important for the human body, are present in the largest quantities. The presence of Cu and Zn is also provided in the body in the required amount. Of course, the presence of these in bread products in normal quantities ensures food safety for human life. A chromatogram of the 1st grade wheat flour produced by the Surkhondonmakhsulotlar JSC (Termez city) (2 kg from a 55-ton batch were tested) was obtained for toxic elements cadmium, arsenic, lead, mercury, lead and copper, mycotoxins, and iron. The chromatogram graph showed that the flour under study contained only lead: 1.8 mg/kg; iron element - 20 mg/kg. The tests were conducted in laboratory conditions with a relative humidity of 48% and a temperature of -220 C. The total acidity was found to be 1.20. A similar study was conducted on 1st grade wheat flour obtained from 4 batchers produced by the Surkhondonmakhsulotlar JSC It was found that: in the flour in the dispenser No. 1, the alcohol content was -1.9 mg/kg; in No. 2, it was -2.0; in No. 3, it was -1.8; and in No. 4, it was -2.2; the iron element was -30. 25, 30. 25 mg/kg and the acidity was: 0.9, 0.8, 1.0, 0.80. The laboratory showed that the relative humidity was 54%, the temperature was 200 C[4.5]..

The flour of the 1st grade wheat flour produced by “Sariosiyo Don” LLC also had alcohol content of -16.0 mg/kg, iron content was 60.0 mg/kg, acidity was -0.80, the laboratory tested it had a relative humidity of 48%, the temperature was -230 C. Toxins and mycotoxins were not detected. The flour produced in the Samarkand branch of the “Osiyo-Afrosiyob” enterprise The chromatogram for cadmium, lead, mercury and copper, which are considered toxic elements, showed that the flour studied contained only copper, and no lead.

The amount of copper in 1 kg of flour is 2.18 mg, and mercury - 17 mg. This amount is considered harmless and even beneficial when consumed with normal bread products, since the

daily human intake of copper is 0.5 mg per kg of body weight. The amount of toxic elements at the enterprise level is given in the table.

Table 3

Amount of toxic elements of grain products of Surkhandarya and Samarkand regions at the scale of enterprises, mg/kg.

Токсик элементлар	Сурхондонмахсулотлар" АЖ (Термиз ш.)	SA"Шурчи дон мхсулотлар" АЖ	"Сариосиё Дон" МЧЖ	"Жомбой дон махсулотлар" АЖ (Самарканд ш.)	МЧЖ GPM Realty TOO "Зополя" буғдой уни (Тошкент ш.)	"Осиё-Афросиёб" Самарқанд филиали
Fe	20	25-30.	60,0	56	22	43
Cu				2,32	1,3	2.18
Zn	1,8	1,9-2,2	16,0	18	2.1	17

The first-grade flour produced from wheat grains grown in Surkhandarya is much less than that produced by enterprises in the Samarkand region. In our opinion, this is probably due to the diversity of the soil structure and climatic conditions in which it is grown. In addition to the above-mentioned metal toxins, the chemical composition of bread dough and bread products was studied: amino acids in protein, fractional structure of monocarbanyl compounds, fatty acids in their composition. Based on the developed methodology for the study of biological hazards in bread raw materials, grains and flour, bread, the effect of cellular and traditional heat treatment on spore-forming microorganisms was studied, and the results obtained are presented in Table 2.

Table 4

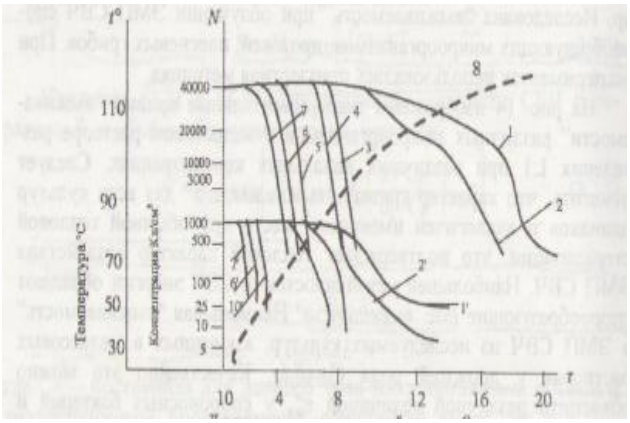
Effects of UYUCH and conventional thermal processing on spore-forming microorganisms.

№	Sample	Microorganisms starter concentration cell/cm^3	Ambient heating temperature ^{,0}C	Duration of effect Sec	Concentration of microorganisms, cell/cm3	
					After the UYUCH	Post-traditional
1.	Wheat grain	$2{,}0\cdot10^2$	65	90	120	$2{,}2\cdot10^2$
		$3{,}5\cdot10^3$	75	100	22	$4\cdot10^3$
2.	Flour, 1st grade	$12{,}0\cdot10^3$	65	90	3	$8\cdot10$
		$25\cdot10^3$	75	100	50	$11\cdot10^2$
3.	Bread (with a crust)	$6{,}0\cdot10^2$	65	90	0	$4\cdot10$
		$6{,}5\cdot10^3$	75	100	0	$4\cdot10^2$

The results of the study conducted at different temperatures 65, 750C. and duration 90, 100 sec, as well as the initial concentrations and final temperatures, showed that the composition and number of cellular microflora during microwave irradiation were significantly lower than in the traditional method. Also, the sterilization time of 200 g of bread packaged in polyethylene bags was 15-20 s, and the temperature of the bread crust was 50-60 0C, while in the traditional

heating method it was -85-900C. According to the results of experiments on the storage of this bread, if we heat the packaged bread in the electromagnetic field of the microwave irradiation for 15-20 s every 6-7 days, the shelf life of the bread can reach 60 days.

Bactericidal and mycocidal effect of EMM energy on pasteurization of flour and bread products was confirmed by the "survival" curve of microorganisms in molasses at the initial concentration in experimental variety (7 types of microorganisms). The curves of "survival" of microorganisms in molasses of different initial concentrations are presented in Figure 2.



1–Bac.Mecentericus2-Bac.Megathrium;3-Leukonostos mesenterloides;4-Lenkonostos agglutinans; 5-Candida guill; 6-Candida mycoderma; 7 - Candidada Solani; 8-UYuCh heating temperature.

Figure 2. The curve of "survival" of microorganisms in molasses of different initial concentrations.

UYUCh heating time, c

As can be seen from the figure, the "survival" curve is the same for all microorganisms, similar to simple heat pasteurization. This indicates the thermal effect of the electromagnetic field energy of the UYCH. The "survival" microorganism in relation to the energy of the UYCH electromagnetic field is the moldy "Bactesemtericuc" type. The microorganisms of the genus Candida, which are resistant to it, are yeasts grown in a molasses solution. The reason for this difference is that their dielectric permittivity ε_кл^" is different. Fungal bacteria are resistant to the influence of the electromagnetic field УЮЧЧ, because the ε_кл^" of their fungal cell is low, and their death is relatively high. Therefore, we determined the dielectric properties (conductivity) of the crust (crushed) and soft part of wheat grain, flour, bread using the experimental "Short Circuit" method, the obtained and calculated data are presented in Table 5:

Table 5
Dielectric conductivity of grains, flour, and bakery products

No	Grain, flour and bread	Humidity, %	Dielectric conductivity f=2300 mHz t= 〖20〗 ^0 S		
			ε'	ε''	tgδ
1.	Wheat grain	12	2,46	0,66	0,18
2	Wheat flour: top grade 1st grade 2nd grade	 14 14 14	 3,6 3,9 4,1	 0,1 0,2 0,4	 0,03 0,05 0,1
3	Bread: shredded bark soft part	 4-6 42	 0,8 41	 0,09 16	 0,11 0,39

As can be seen from the table, the dielectric constant of cereals, flour and bread depends on their composition and the amount of water in them.

The chemical composition of cereals, flour and bread products was determined using certain standard methods, and the results obtained are presented in Table 6.

Table 6

Chemical composition of wheat grain, flour, and bread, g/100g.

No	Name	Suv		Kul		Uglevod		Oqsil		Yog‘		Qand	
		I	II	I	II	I	II	I	II	I	II	I	II
1.	Wheat grain	14	13,4	1.7	1,7	59.5	58,8	11.8	11,7	2.2	2,1	2.5	2,4
2.	Flour, 1 grade	12	11,5	0,58	0,58	76,2	76,8	9,71	9,8	1,48	1,47	2.1	2,1
3.	Bread (with crust)	35	34,8	2,01	2,0	47,5	47,3	10,6	10,3	4,53	4,5	2,4	2,3

I – by traditional method: II – by means of UYUCH electromagnetic energy.

The table shows that the electromagnetic energy of the UYUCH practically does not change the chemical composition of grains, flour, and bread.

4. Conclusions. 1. The effectiveness of using complex antibiotic plant additives, ionizing, infrared radiation, and ultra-high frequency (UYUCH) microwave method in wheat flour bread technology to prevent the development of spore-forming bacteria and mold fungi has been confirmed.

2. Based on the existing electrophysical laws in ensuring the microbiological safety of grain, flour and bread products, the effect of UYUCH EMM energy on microorganisms is mathematically based on the physical-thermal effect.

3. An experimental device and research methodology for disinfestation of grain (killing insects in its composition) and disinfection of flour and bread products (killing microorganisms) with UYUChli were developed.

4. In microwave UYUCH disinfestation: mill moth, barn moth and grain moth at Ruyuch = 0.25 kW for 20-30 s. The remaining ones were killed for 30 seconds at Ruyuch = 0.36 kW, and if we increase the power to Ruyuch = 0.45 kW, and reduce the time to 20 seconds, they were completely killed.

5. The effect of microwave and conventional heat treatment on spore-forming microorganisms was studied. The composition and number of cellular microflora during microwave microwave treatment at the initial concentration of microorganisms and the final temperature were several times lower than in the traditional one.

6. The results of monitoring and experiments conducted at grain, flour and bread enterprises in the Surkhandarya and Samarkand regions confirmed the absence of toxins and mycotoxins in the wheat grain grown in different years, the produced flour and bread products, and the presence of various amounts of microelements in their composition at the required level.

7. Grade 1 flour produced from wheat grain grown in Surkhandarya is significantly lower than in enterprises in the Samarkand region. The flour produced for “Obi-non” has a normal level of toxic elements, there is no risk of consumption. The chemical safety of “Obi-non” dough and bread has been confirmed in terms of: amino acids, monocarbanyl compounds, fatty acids, and mineral composition.

8. To disinfect grains from various insects, CELLULAR disinfestation is necessary, and to ensure the microbiological safety of flour and bread, CELLULAR disinfection is necessary.

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