

Find Out the Suitable Method to Reduce Residual Pesticides Load from the Harvested Vegetables

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Abstract: Bangladesh is a densely predominant agricultural country with fertile lands whose farmers are trying to grow more and more crops, fruits, vegetables from his limited land by using high yielding varieties or genetically modified crops, chemical fertilizer, etc. which have many negative indicators such as different types of microorganisms, pests or diseases. These genetically modified crops or vegetables, excess chemical fertilizer, warm and humid climate are highly favorable to develop or grow and multiplication of microorganisms or pests. Especially, vegetables and fruits are seriously attracted by different microorganisms and in un-controlling condition, agricultural products are abruptly reduced; even sometimes 100% reduced. So, without pesticides using it cannot imagine to grow or expected product yield is impossible; however the pesticide is red alarming for human health. Now question arise, what is the solution of this critical problem? In this respect, we have visited to the fruits and vegetables cultivars to assemble the information about pests and its control. According to their information, mostly used pesticides are cypermethrin and dimethoets, (1ml per liter in water) that were selected and sprayed. The pesticides sprayed vegetables were treated under following physical condition to reduce residual pesticides- wash in water, submerged in warm water, 2% vinegar and 2% NaCl for 15 min. After treatment, the residual pesticides were extracted and analyzed by GC. More than 80% residual pesticides were found in peel of the cucumber. About 75% both pesticides were reduced when cucumber were submerged in luke warm water for 15 min whereas, more than 80% residual dimethoets were reduced when submerged in 2% NaCl for 15 min, respectively. From these results, it can be suggested that the raw fruits and vegetables should be consumed without peel but, the fruits and vegetables that is eaten with peel, should be submerged in like warm water for more than 15 min before taken to reduce harmful effect of pesticides and safe human being from many life threaten diseases like caners.

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I. Introduction

Bangladesh is a densely predominant agricultural country with an area of 1,47,570 square km with fertile lands who cultivates a lot of crops, fruits and vegetables. Unfortunately, she has only 0.31% of the total agricultural land in the world but bears more than 2% of total population of the world [1]. The cultivating lands are decreasing day by day. Bangladesh bears more than seventeen core people, who are depend on agriculture directly or indirectly. The agriculture contributes about 50% of GDP and 80% of the total earning in Bangladesh [2]. So, agriculture plays a key role in our development. In time, agricultural land decreases with population increases. On the other hand, the people give top most priority to fresh vegetables and fruits when select their food items. The demand of fresh vegetables is increasing at such a high rate as it provides significant amount of taste, vitamin, minerals, fiber and other nutrients and at the same time it constitutes a very little amount of carbohydrate and fat. Bangladesh for its tropical and subtropical climate produces a large amount of vegetables and fruits. There are about 100 different types of vegetable comprising both local and exotic type are grown in Bangladesh [3]. The rank of Bangladesh for vegetables production in the world is third who produce more than 26 million MT annually [4, 5]. Instead of such high production volume, still the present rate of consumption of fruits and vegetables remain 166.1 g per day per capita [5] which is far below from the minimum daily requirement of 400 g per capita as recommended by FAO and WHO [6]. Since, vegetables and fruits cultivation is more profitable than any other crops production; the farmers are tended to cultivate vegetables and fruits. Therefore, our main headache is how to grow more and more fruits or vegetables within this limited land to fulfill our demand. To fulfill the demand, our farmers are trying to grow more and more crops, fruits or

vegetables from this limited land by using genetically modified or high yielding crops, by applying chemical fertilizer, *etc.* however, some natural factors like fertile land, warm and humid climate, enough rainfalls are also help to fulfill the demand. Out of these positive factors, there are some negative factors like drought, excess rainfall, flood, pests and pests or microorganisms related diseases are involved in our agriculture sector. Out of them, most alarming factor is pests or microorganisms (Fungus, bacteria, virus, etc) [7]. Most of the agricultural products are damaged by pests. Especially, vegetables and fruits are seriously attacked by pests, and the yield per unit area is quite low. In un-controlling condition, agricultural products are reduced about 50%; even sometimes 100% are reduced [8]. The genetically modified or high yielding varieties crops, fruits or vegetables, excess chemical fertilizer; all of these factors are highly favorable to develop, grow and multiplication of pests or microorganisms. The excess rainfall, warm and humid climatic condition is also favorable to grow or multiplication of pests.

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest [9] whereas, the organisms that damage crops, forests, or property are called pests such as fungus, insect nematode, rodent, weed, or other form of terrestrial or aquatic life form that is injurious to human or farm animal health or interferes with economic activities such as agriculture and logging are also known as pests [10, 11]. Unfortunately, when the pesticides exposure in human being to create a serious health hazard and they face the following problem- carcinogenicity, mutagenicity, teratogenicity, oncogenicity, liver damage, reproductive disorders, nerve damage, allergenic sensitization, coma *etc.* that ultimately result is death or disable [12]. The cultivars try to control the pests by spraying different pesticides that create a serious health hazards and the pesticides spraying increasing frequently [13]. The pesticides effect is not only on human body but also on all over the environments. So, it clear that without pesticides we cannot imagine to cultivate crops especially vegetables and fruits. There is a caution to pesticides manuals, minimum seven days wait for harvesting the fruits and vegetables after pesticides using. But, scenario is totally contradictory; our farmers are harvesting the fruits and vegetables within a few hours or a day after spraying and the pesticides are active in harvested fruits and vegetables; consume by human that create a severe health hazard. From these short discussions it is clear that pesticides must be used to fulfill our demand though, the pesticides create health hazard and one type of slow poisoning to human which ultimate result is death. In this critical situation, light comes from the words that most of the pesticides are destroyed by heat during cooking [14]. But what do about consuming fresh fruits and vegetables like strawberry, guava, green chili, cucumber, tomato, *etc.* Now, question arises how to solve this life threatening problem. Now it has become a great challenge to find out and efficient and effective method to reduce residual pesticide. So, we are interested to find out the suitable way to remove or reduce residual pesticide from the fruits and vegetables before consuming. In this respect, we have undertaken this project. In this study, we have selected cucumber as an experimental vegetable which is one of the most fresh/raw consumed delicious vegetables used as salad in Bangladesh as well as in world wide. First, we have collected the information from the cucumber cultivars and after than find out the suitable way to reduce residual pesticides from the fresh cucumber.

II. Materials And Methods

All of the chemicals were used in analytical grade and the work has been done in the laboratory of the Department of Applied Nutrition and Food Technology, Islamic University, Kushtia and in the Division of Entomology, BARI, Gazipur. Subdivision was done by the following descriptive treatments.

2.1 Study Subject

The information about cucumber cultivation was collected from the cucumber cultivars by questionnaire method. We have contacted with 40 farmers who cultivate cucumber commercially at the different villages in Kushtia district. The person was selected randomly.

2.2 Selected field

We have selected a small land for cultivation of cucumber at Kumarkhali, Kushtia and sprayed mostly used pesticides- cypermethrin and dimethoets. The land is divided into three plots: Plot/Group-1: Control Cucumber (CC-0) field (without pesticide); Plot/Group-2: Cypermethrin (Caught 10 EC) (1 ml/ liter) was sprayed and Plot/Group-3: Dimethoets (Sungor 40 EC) (1 ml/liter) were sprayed before harvesting the cucumber. After spraying the samples were harvested within 8 hours the samples were collected, subdivided (10 subgroups) and residual pesticides were determined in the laboratory.

2.3 Physical Treatment of harvesting cucumber

Group-1: CC-0 (Cucumber control); Group-2: Cypermethrin sprayed Cucumber; CC-1: Standard (Untreated); CC-2: Wash with running water (RW); CC-3: Submerged in water for 15 min, (SW); CC-4: Submerged in luke warm (40-45°C) water for 15 min (SLW); CC-5: Submerged in 2% vinegar for 15 min (SV); CC-6: Submerged in 2% NaCl for 15 min (SS); CC-7: Submerged in 2% vinegar for 15 min & wash with water (SV & RW); CC-

8: Submerged in 2% NaCl for 15 min and wash with water (SS & RW); CC-9: Pulp (Without peel); CC-10: Peel. Group-3: Dimethoets sprayed Cucumber; CD-1: Standard (Untreated); CD-2: Wash with running water (RW); CD-3: Submerged in water for 15 min, (SW); CD-4: Submerged in luke warm (40-45°C) water for 15 min (SLW); CD-5: Submerged in 2% vinegar for 15 min (SV); CD-6: Submerged in 2% NaCl for 15 min (SS); CD-7: Submerged in 2% vinegar for 15 min & wash with water (SV & RW); CC-8: Submerged in 2% NaCl for 15 min & wash with water (SSS & RW); CC-9: Pulp (Without peel); CC-10: Peel.

2.4 Extraction of residual pesticides

To determination of residual pesticides, 300 gm of cucumber was cut into small pieces and homogenized thoroughly with the blender. The sample was extracted in acetone with addition of 4 gm of anhydrous MgSO₄ and 1 gm of NaCl and shaking vigorously for 1-2 minutes, centrifuged at 5000 rpm for 5 minutes to remove interferences and extract was collected & concentrated under reduced pressure by using rotary vacuum evaporator. The concentrated extract was rinsed with DD n-hexane (commercially purchased n-hexane was purified through a solvent distillation plant and double distilled n-hexane was prepared) at least three times. The extract was clean up by the florisil column chromatographic. The column was prepared with activated florisil gel in DD n-hexane and the extract was centrifuged at 10,000 rpm for 5 minutes and supernatant was filtrated 0.45 mm filler paper. The supernatant was ready to apply in gas chromatography.

2.5 Determination of residual Pesticides

The filtrate was ready to inject into the GC-FTD, Column: Rtn-OP: Pesticides; Injector Temperature: 240°C; Carrier gas H₂/Air and Carrier gas flow H₂- 1.4 ml/mi; Air – 145 ml/mi. Before injection of the sample, standard solutions of different concentrations of Cypermethrin and Dimethoets were prepared and injected with selected instrument parameters and calibrated (retention time, peak area, *etc*) against three to four pointed calibration curve of standard solution of respective pesticide. The extract samples were injected on the calibrated column. The peak was characterized by the retention time. The results were expressed in ppm automatically by the GC software and residual pesticide was calculated.

III. Results And Discussion

3.1 Results of field study

Most of the farmers (about 80%) gain the knowledge about pesticide and pesticide spraying procedure to control the pests from pesticides sellers or the experience farmers. Most of the farmers (85%) were applied cypermethrin (1 ml/L), and dimethoate (1 ml/L) to prevent the pests of cucumber and a few percentages (10%) were applied 2 ml/L. The responders also informed that more than 60% farmers were applied pesticides at least 20 times per season and after spraying pesticide; they (75%) were harvested cucumber within a day. The results indicated that most of the farmers didn't obey the manual instructions. Former report indicated that most of the farmers (80%) re-enter their farms within 3 days of pesticides application [15].

3.2 Determination of residual pesticides by GC

According to the field level information, we have selected cypermethrin and dimethoets for our research work and these pesticides were sprayed for cultivation of cucumber and before harvesting. The analytical chromatographic patterns were seen in the figure-1, 2, 3, 4 & 5 (All chromatographic patterns are not shown); and analytical results were summarized in Table-1&2. In this work, control (pesticides free sample) and pesticides sprayed sample, standard (without any physical treatment) was introduced and the control and standard means the residual pesticides was 0 and 100%, respectively. Peel of cucumber contained maximum amount of both pesticides (> 85%) whereas, a minor amount contained in pulp (<15%) (Table-1 & 2). About 15% and 30% residual cypermethrin and dimethoets were reduced, respectively when the vegetables were washed in water whereas, more than 65% both of the residual pesticides were reduced from cucumber when cucumber were submerged in water at room temperature for 15 min. But, when cucumber was submerged in luke warm water for 15 min, both of the residual pesticides were reduced more than 75% (Table-1 & 2). Maximum amount (about 80%) of residual dimethoets was reduced from cucumber when submerged in 2% NaCl for 15 min (Table-2) however, there was no significant effect in case of residual cypermethrin reduction (Table-1) and when submerged in 2% vinegar, there were no positive results for the reduction of both pesticides from cucumber (Table-1 & 2) The result is supported by the report of Graziela *et. al.* 2015 and Liang *et. al.* 2012 [16, 17]. Sodium chloride (2%) was suitable and fruitful for reduction of residual dimethoets load from the cucumber whereas, both pesticides were significantly reduced when the cucumber was submerged in warm water for 15 min. From these results, it can be suggested that warm water is more easy, suitable and economic to reduce residual pesticides than sodium chloride (2%) solution.

IV. Figures And Tables

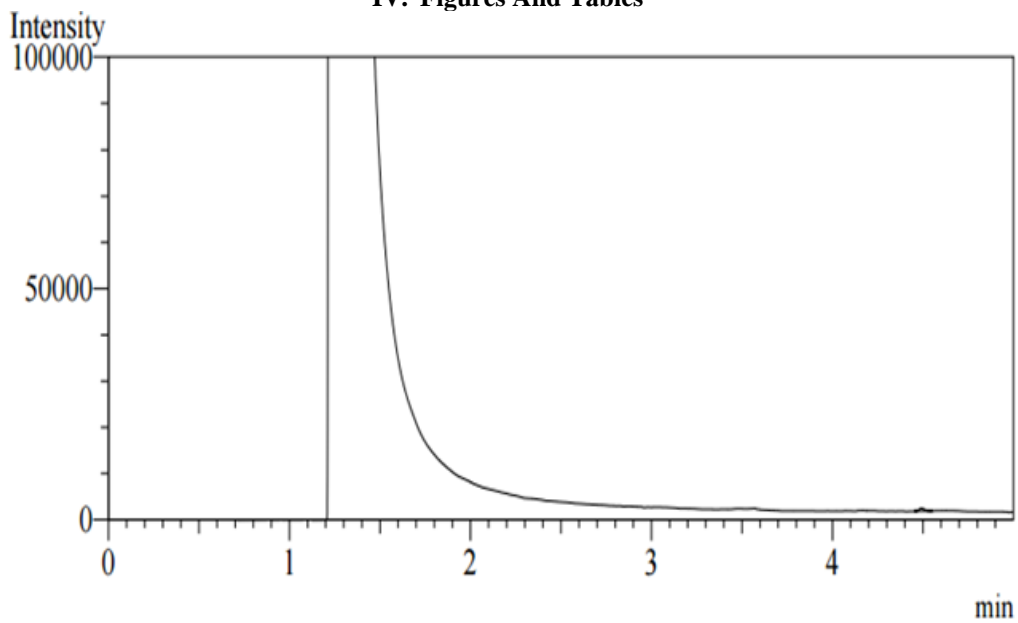


Fig. 1. Chromatographic pattern of Control (without pesticide); CD-0, RT (retention time) 4.495 min, Area-not detected.

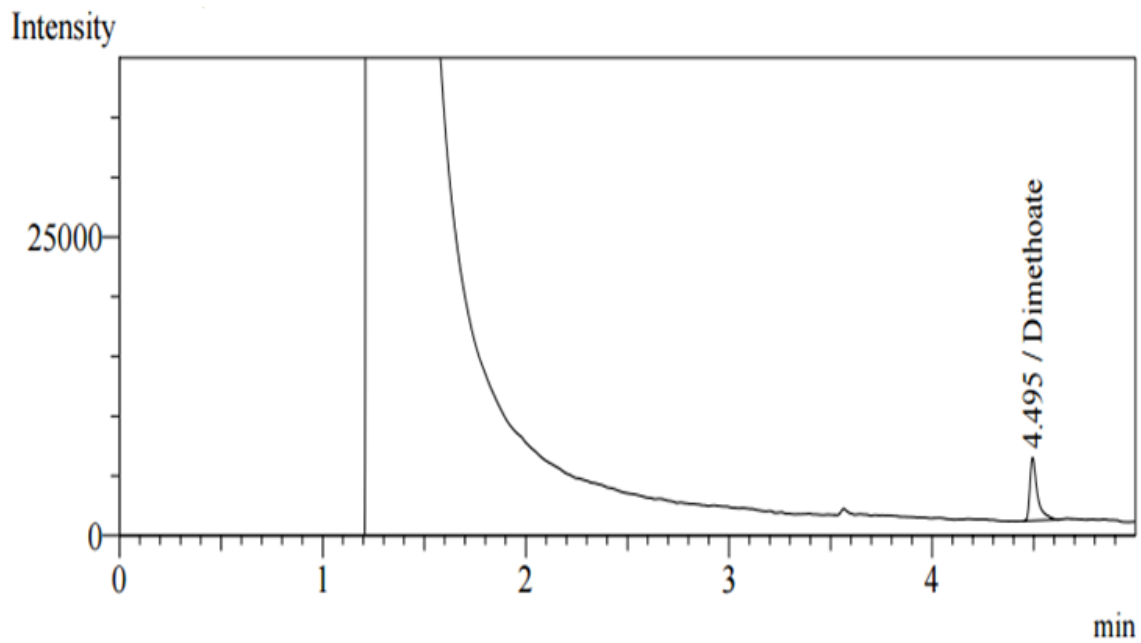


Fig. 2. Chromatographic pattern of Standard (Untreated) cucumber, CD-1, RT- 4.495 min, Area- 13615.

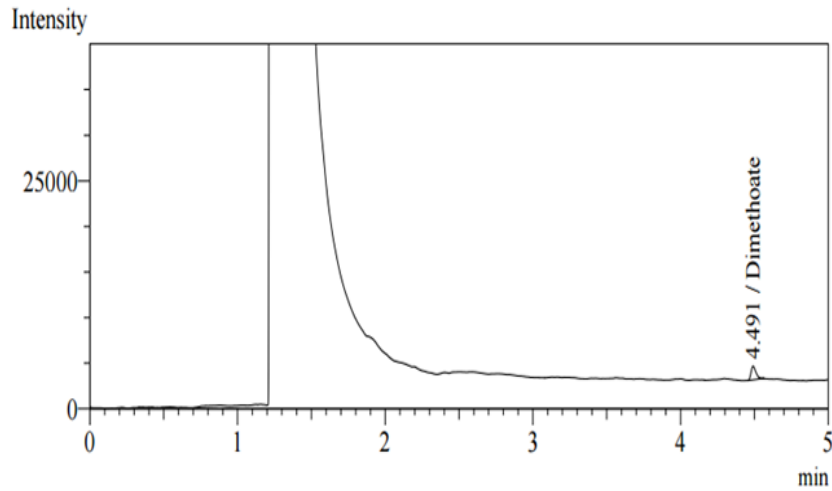


Fig. 3. Chromatographic pattern of cucumber extract that submerged in luke warm water (40-45°C) for 15 min, CD-3, RT- 4.491 min, Area-3471

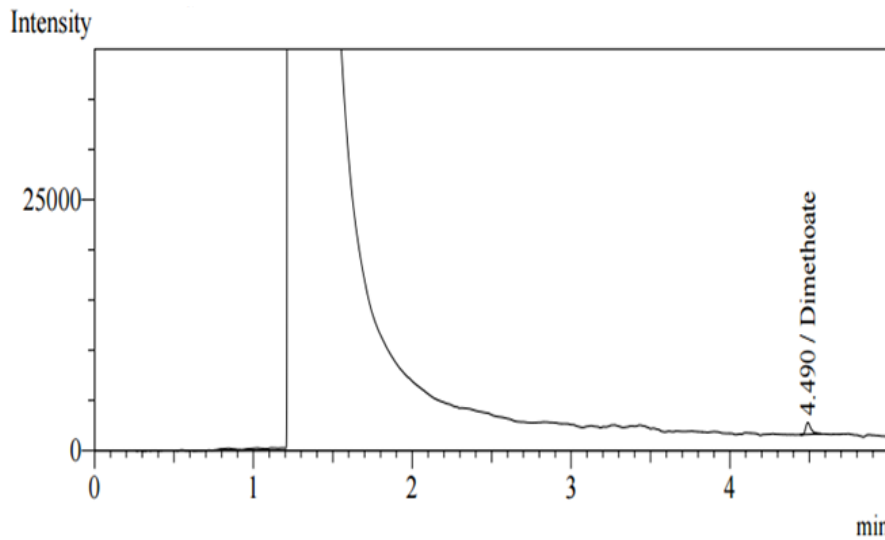


Fig. 4. Chromatographic pattern of cucumber extract that submerged in 2% NaCl solution for 15 min, CD-6, RT- 4.490 min, Area-2689.

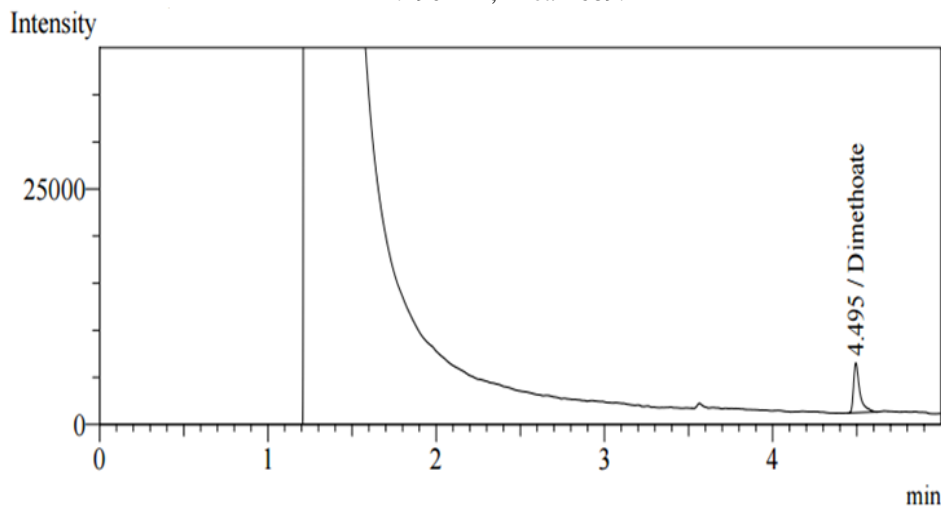


Fig. 5. Chromatographic pattern of cucumber peel extract, CD-10, RT- 4.495 min, Area-11436.

Table-1. Analytical data of cypermethrin in cucumber after different physical treatment

Sample No.	Treatment	Average	Remaining (%)	Reduced (%)
CC-0	Blank	Not detected	-	-
CC-1	Standard	54330.5	100	0
CC-2	RW	47736.4	88	12
CC-3	SW	20395.5	38	62
CC-4	SLW	15755.6	29	71
CC-5	SV	42388.7	78	22
CC-6	SS	30951.2	57	43
CC-7	SV & WLW	38142.8	70	30
CC-8	SS & WLW	29651.2	55	45
CC-9	Pulp	5416.1	10	-
CC-10	Peel	46897.0	85	-

Table-2. Analytical data of dimethoets in cucumber after different physical treatment

Sample No.	Treatment	Average	Remaining (%)	Reduced (%)
CD-0	Blank	Not detected	-	-
CD-1	Standard	13615.5	100	00
CD-2	RW	9499.8	70	30
CD-3	SW	4345.4	32	68
CD-4	SLW	3471.8	25	75
CD-5	SV	6099.2	45	55
CD-6	SS	2689.4	20	80
CD-7	SV & WLW	5859.8	43	57
CD-8	SS & WLW	2689.4	20	80
CD-9	Pulp	2036.2	15	-
CD-10	Peel	11436.0	84	-

V. Conclusion

Pesticides are toxic material, widely used for protection of crops, preservation of food, prevent from insect or pests of plants but create many problems in public health and health hazards [18, 19]. Due to the geometrical increasing of population in the world, food crisis is a common figure; to meet up the crisis, increase the agricultural product by any means. In this respect, pesticide is playing an extremely important and irreplaceable role in maintenance to increase agricultural productivity [8] but it seriously affected human being. Thus WHO involved since 1963s to ensure the public health by increasing the awareness of pesticide use. Although the pesticide Rule, 1985 of Bangladesh strictly prohibits any kind of unauthorized of pesticides, it does not work effectively to control hazardous pesticides because of lack of strong monitoring and proper evaluation facilities [20]. Vegetables and fruits are seriously attracted and in un-controlling condition, agricultural products are abruptly reduced; even sometimes 100% reduced. So, without pesticide it cannot imagine to grow and yield expected product is impossible [8]. Now question arise, how to reduce pesticides load in harvesting vegetables or fruits? In this regards, we have undertaken the preset study and from this study we have concluded that most of the residual pesticides are contained in outer part of the fruits and vegetables (peel) and minor amount in inner parts (pulp). So, we should be taken fresh or raw fruits and vegetables without peel and the fruits and vegetables (Tomato, Guava, Grapes, Green chili, etc.) that have taken with peel should be submerged in warm water at least 15 min before consumed.

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