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## **Increasing quality of separation of shelled peanuts by X-rays and IR technologies**

### **Abstract**

One of the important requirements of the market to peanuts in shell is the lack of incompletely filled with fruit. Traditional mechanical sorting methods cannot solve the problem completely. In this work experimentally proved the possibility of the complete removal of immature fruits ("singles") by using image processing of x-ray and infrared

### **Introduction**

Peanuts in shell is a popular product in Europe. Market volume is about 60 thousand tons annually, and 10 % of supplied from Israel [1]. One problem with this product is the presence of empty seats in the fruit, which leads to their burning when frying. Traditional mechanical separators cannot solve the problem, which makes it necessary to search for new possibilities [2]. In the search for solutions, we have tested the abilities of the computer image processing methods of images obtained in x-rays, visible and infra-red spectrums.

### **Materials and methods**

Experiments were performed on shelled fruits of peanuts, produced by company NIR-agricultural works Ltd. (Israel). Sampling volume was 1000 peanuts, selected during day of work. Images in visible light received by a digital B/W camera "Jeveline" when lighting by white LED emitters CRI-97 under light intensity 50 W/cm<sup>2</sup>. X-ray images were obtained on computerized silk cocoons sorting system SM-SC-01 when the voltage on the tube 18 KV and current 35 mA [3]. Images in the infrared range were obtained on the camera FLIR SC 660 [4]. Heating is carried out in the microwave with power 1 KW during 5 -10 sec. For cooling was used air conditioner "LG Inventor V" and steel mesh( cells 4x4 mm).

### **Results**

On received pictures it can be seen that the x-ray method allows to obtain a clear image (Fig.1) .

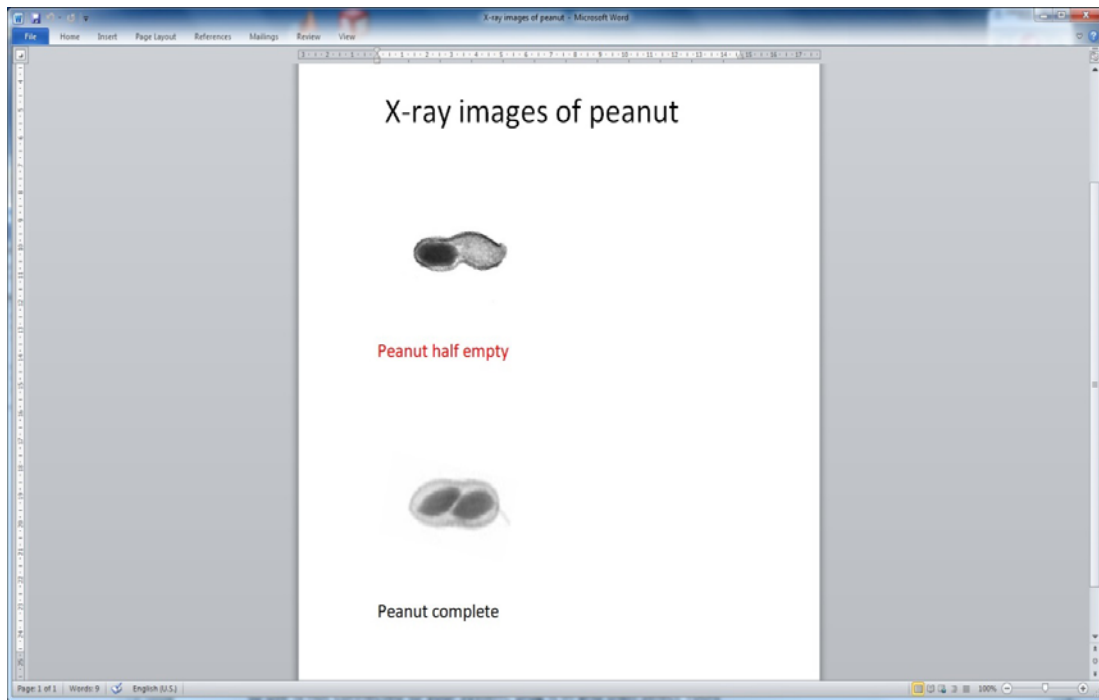


Fig.1. X-ray image of peanuts

Besides that, it can be seen that the form of empty part of the fruit have different shape than complete. However, visual sorting showed that different in shape happens in 60-70% only and strongly depends on the position when shooting, Fig.2.



Fig.2. Peanut fruit image under white light

The image in the infra-red range showed that in the case of heating microwave empty and full of the fruit have different temperatures and therefore differ from each other (Fig.3. ).

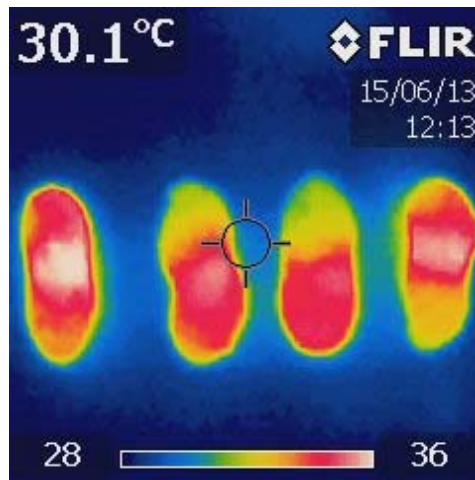


Fig.3 IR image after heating. (left –complete fruit; right –empty, two other – with pure developing)

All part of the original fruit have equal temperatures and does not give anyone the image, Fig.4.

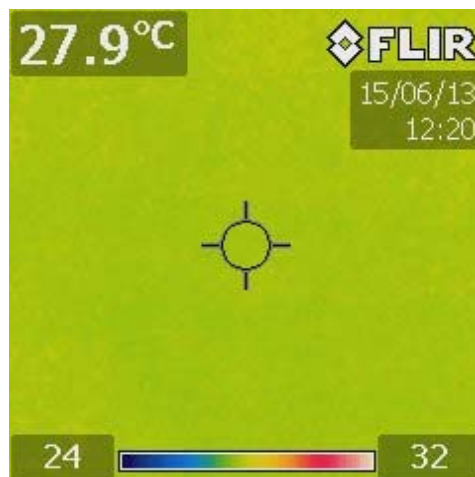


Fig.4. IR image of initial fruit ( control)

Based on these results, it was assumed that possible get the temperature difference by other way - fast ventilation by cold air through fruits of peanut . To test this hypothesis the original fruits were placed on the screen and with a temperature of 28 C, was send air with temperature 20 C. for 1-3 seconds. As seen on the photo (Fig. 5), the empty and full part in clarity, because the more massive and dense seed cooled significantly slower than shell.

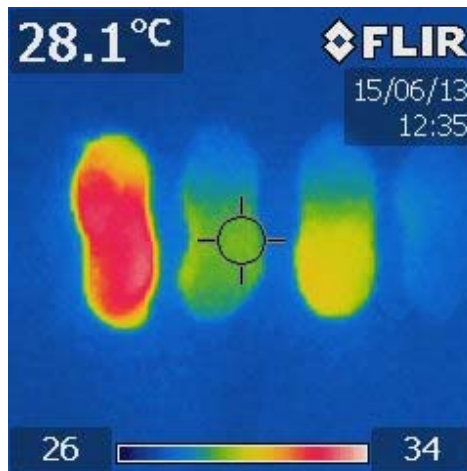


Fig.5 IR image after air cooling. ( left –complete fruit; right –empty, two other – with pure developing)

Obviously, one hundred defective fruit can be removed using well-known techniques of image processing and industrial automation. It should be noted that analysis of the image of calls that their temperature is about the same, making it possible to use not only expensive infrared cameras , but also cheaper sensors and build industrial sorter on the basis of microcontrollers.

### Conclusions

The first is shown full selection of immature fruit peanuts in shells with their shooting by X-rays imaging or in infrared spectrum after all possible temperature treatment (as short-term cooling , microwave heating or etc.), which bring properties to get different temperature of parts of peanut fruit.

### References

- 1.FAO (Food and Agricultural Organization of the United Nations) Food Outlook 1990, Rome, Italy.
- 2.Peanut science and technology. 1982. Ed. by H.E. Patee and C.T. Young, American Peanut Research and Education Society, Inc.. Texas
3. Silk cocoons sorting systems ([www.youtube.com](http://www.youtube.com))
4. [www.flir.com/Thermography cameras](http://www.flir.com/Thermography%20cameras)