Investigation Spectral Characteristics of Onions in Training Neural Network

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Abstract **- One of the basic stages in fruits and vegetables grading includes the study of their spectral characteristics of transmittance and reflectance and the determining of those wavelengths, at wich the difference between the separate classes is the greatest. The structure of the objects investigated (onion tubers) and the development of diseases in them have shown that in order to use Neural Network (NN) during their quality evaluation (qualification), an information should be received concerning their total inner and outer status.**

Keywords **- Spectral Characteristics, Training, Neural Network, Qualification.**

I. INTRODUCTION

One of the main stages and vegetables grading is the study of their spectral characteristics of transmission and determining of those wavelengths in wich there is the greatest difference between the separate classes. The first step in this stage is the determining of the most suitable range for carrying out the spectrophotometric investigations upon the separate fruit or vegetable. According to the recommendations of some authors and the experience gained by the work team, the studies have been directed within the range 550-900 nm of the visible and a part of the near infrared region of the electromagnetic spectrum. They have been carried out on the spectrophotometric assembly for the two most widely spread varieties of onion in our country-"Liaskovski-58" and "Ispanska-482". A part of the data have been put down on the photometric assembly at the Department of "Automatics, Information and Control Technique" at the University of Food Technologies-Plovdiv, and another part have been obtaind by means of the of the sensor module of the sorting mashine aqs 602.

As a result of the scanning of the product along its lengthwise dimension, a realization of the following type has been obtaind:

$U = U_{\lambda i} / U_{\lambda j}$ ($U_{\lambda i}$ and $U_{\lambda j}$ are voltage signals,

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II. EXPERIMENTAL STUDIES

For the purpose of experimental studies, excerps of tubers have been selected, on which an expert assessment has been done, according to outer indications, by experts. All tubers have been divided into three qualities: 1 quality-corresponding to the requirements of the BSS(Bulgarian State Standard) and the European Standard(ES) for Class I; 2 quality-corresponding to the requirements of the latter standards for Class II; to this quality also belong some diseased tubers with a reserved commersial appearans; 3 quality-tubers, having diseases that have developed to such a degree that they have turned to be completely out of use.

Tables I, II, III present results from recording the spectral characteristics of transmission of the onion tubers. In I line it is the tuber number, in I column- it is the wavelenght in nm, while in the remaining cells of the table-there are the ratios between the two informative wavelengths in % [1], [2].

TABLE I

№ nm	1	2	3	4	5	6	7
550	6	6	0	1	6	2	13
575	9	7	0	1	8	3	15
600	12	11	0	2	12	3	21
625	15	16	0	2	16	4	26
650	19	21	0	3	23	5	33
675	22	26	0	5	30	6	41
690	25	30	2	6	37	7	47
700	17	33	5	9	43	10	50
725	32	40	13	26	54	21	60
740	38	46	17	33	63	26	66
750	45	59	26	44	70	35	73
775	54	63	43	59	78	49	82
800	85	82	88	89	100	86	90
825	100	100	100	100	100	100	100
850	98	100	77	95	100	86	112
875	88	100	61	78	81	69	102
900	88	100	61	61	76	69	100

TABLE II

№ nm	8	9	10	11	12	13	14
550	12	11	6	6	9	7	4
575	16	13	7	7	11	9	6
600	20	17	10	9	13	12	7
625	26	22	12	12	16	15	9
650	32	25	16	17	21	22	11
675	39	30	21	22	25	31	15
690	45	34	28	30	32	40	20
700	48	36	32	35	37	46	23
725	58	44	41	44	49	52	31
740	64	49	47	50	55	56	34
750	71	57	55	59	64	63	46
775	74	67	65	69	72	69	58
800	90	84	92	66	94	92	87
825	100	100	100	100	100	100	100
850	100	99	90	92	86	83	88
875	95	102	83	80	81	76	79
900	95	93	68	66	76	62	67

TABLE III

№ nm	15	16	17	18	19	20
550	4	10	4	2	7	0
575	5	12	6	6	12	1
600	6	15	8	10	16	2
625	8	20	11	13	20	3
650	11	24	15	18	21	6
675	14	29	20	24	20	9
690	19	34	27	48	52	19
700	23	36	31	61	64	27
725	33	45	41	53	65	36
740	38	49	47	54	62	41
750	46	58	56	66	71	51
775	55	66	67	78	79	64
800	86	80	91	108	115	97
825	100	100	100	100	100	100
850	86	97	97	72	68	86
875	81	91	80	67	52	80
900	68	86	73	67	46	72

Fig. 1 and 2 give the spectral characteristics, respectively of healthy (unaffected) (1 and 2 quality) and affected tubers (3 quality), after the data from tables I,II, III. On the X-axis, the wavelength in nm has been ploted, while on the y-axis, it is the ratio between the two informative wavelengths in % that has been plotted [3], [4]. From the spectral characteristics of transmission on unaffected and affected tubers it can be established that the most significant are the differences between them within the range of 700-750 nm and 850-900 nm [5].

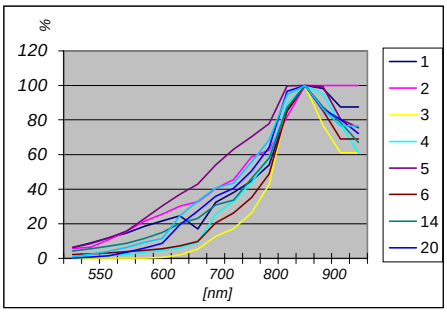

Fig. 1. Spectral characteristics of unaffected tubers

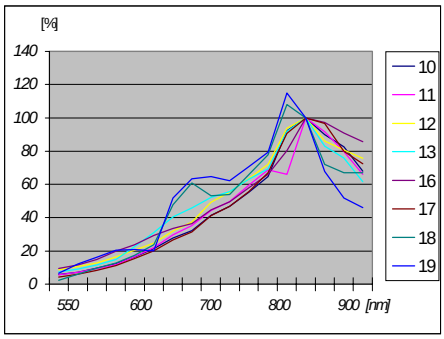

Fig. 2. Spectral characteristics of affected tubers

III. CONCLUSION

Onion as an object of NN training, as well as its grading by means of the so far training NN, is in itself a unhomogenious and changing structure, that has been connected with the variety peculiarity, variations of the shape and size, unhomogenious ageing, different himidity, etc. These parametres influence the data regirtering by using the spectral method.

REFERENCES

[1] T.C. Kirova, Neural Networks, Basic Architectural and Training Algorithms, Softex, Tempus JEP 1497, Sofia, 1995.

[2] H. Demuth and M. Beale, Neural Networks Toolbox, For Use with MatLab, User's Guide, The Mathworks, Inc.,1994.

[3] Matlab, High-Performahce Numeric Computation and Visualization Software, Classroon Kit Guide, The Mathworks, Inc., 1994.

[4] Matlab, Introductional Guide, Contemporary Systems for Control Centre, III. 1994.

[5] K. Hornik, Multilayer feedforward networks are universal approximators. Neural Networks, 2, 359-366,1989.