RS Global Journals

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw, Poland 00-773
Tel: +48 226 0 227 03
Email: editorial_office@rsglobal.pl

JOURNAL	World Science
p-ISSN	2413-1032
e-ISSN	2414-6404
PUBLISHER	RS Global Sp. z O.O., Poland

ARTICLE TITLE	RATIONALIZING THE TECHNICAL AND TECHNOLOGICAL PARAMETERS OF SEA BUCKTHORN REFINING EQUIPMENT
AUTHOR(S)	Ganbold Dagvadorj, Tuvshinjargal Dorjsuren, Baatarkhuu Dorjsuren
ARTICLE INFO	Ganbold Dagvadorj, Tuvshinjargal Dorjsuren, Baatarkhuu Dorjsuren. (2022) Rationalizing the Technical and Technological Parameters of Sea Buckthorn Refining Equipment. World Science. 4(76). doi: 10.31435/rsglobal_ws/30062022/7838
DOI	https://doi.org/10.31435/rsglobal_ws/30062022/7838
RECEIVED	02 June 2022
ACCEPTED	18 June 2022
PUBLISHED	29 June 2022
LICENSE	This work is licensed under a **Creative Commons Attribution 4.0 International License.**

RATIONALIZING THE TECHNICAL AND TECHNOLOGICAL PARAMETERS OF SEA BUCKTHORN REFINING EQUIPMENT

Ganbold Dagvadorj, *Lecurer, School of Engineering and Technology, Mongolian University of Life Sciences, Ulaanbaatar, Mongolia*

Tuvshinjargal Dorjsuren, *Ph.D, Lecurer, School of Engineering and Economics, Mandakh University Mongolia, Ulaanbaatar, Mongolia*

Baatarkhuu Dorjsuren, *Ph.D, Associate Professor, School of Engineering and Technology, Mongolian University of Life Sciences, Ulaanbaatar, Mongolia,*
ORCID: https://orcid.org/0000-0002-0081-9118

DOI: https://doi.org/10.31435/rsglobal_ws/30062022/7838

ARTICLE INFO

Received: 02 June 2022
Accepted: 18 June 2022
Published: 29 June 2022

KEYWORDS

Airflow Speed, Winnowing, Weight, Waste Matter, Refining Degree.

ABSTRACT

Conforming the severe continental weather, wild sea buckthorn clasps in a 14-thousand-hectare area around the river basin, the valley of Mongolia. Moreover, sea buckthorn was planted in 3900 hectares of field, 1.701.278 kg of sea buckthorn was harvested as of 2018. People tend to spend more time and man force refining the sea buckthorn from the waste matter. Thus, the authors set the goal to invent the refining equipment for sea buckthorn and rationalize the parameters f the equipment. For instance, the equipment refines 3.5kg of fruit, blast speed is 10 m/sec, and winnowing fluctuation is 80 min^{-1}. Also, we defined the optimal value and made mathematical modeling of the refinement degree of the sea buckthorn.

Citation: Ganbold Dagvadorj, Tuvshinjargal Dorjsuren, Baatarkhuu Dorjsuren. (2022) Rationalizing the Technical and Technological Parameters of Sea Buckthorn Refining Equipment. *World Science.* 4(76). doi: 10.31435/rsglobal_ws/30062022/7838

Introduction.

As stated in the government's food and agricultural policy, "The cultivation of the sea buckthorn will be increased to 10000 hectares, and other fruits will be increased to 2000 hectares by 2022" [6].

The weight of sea buckthorn is 0,32...0,52 gr, length 3,7...13,2 мм, width 6,1...10,6 мм. The proportion of the length and meridian which are important for cleaning, numbering, and transporting the fruit is between 0,72...0,95 for all sorts, thick 1020 кg/m^3, capacity 770...840 кg/m^3, specific weight 980...1020 кg/m^3, at the beginning of the ripeness 0,24 H, after freezing 3,5...4,5 H break by the pressing power, the yielding module of the fruit branches during the hooking period is 0,3...1,6 / 10^8 Pa [3]. There are plenty of research studies about the aerodynamic properties and physics of the sea buckthorn. However, there have not been any research studies about the equipment for refining sea buckthorn from waste matters since Avdai.Ch, in 1975. The sea buckthorn is harvested with waste matters (leaves, bud, buzz) without considering the harvesting tools, methods, and the ripening period. Therefore, people tend to spend much time and effort harvesting the sea buckthorn.

Nowadays, the sea buckthorn harvested with waste matters is packaged from 5 to 10kg, manually poured by falling, and blown twice with a propeller. Moreover, we spend more time and human resources harvesting the sea buckthorn. A worker spends 8 hours harvesting 10 kg of fruit manually, and 2-3 hours out of 8 hours is spent cleaning the fruit. On the other hand, 25-35% of the

total time is spent cleaning the harvested fruit [3]. Primarily, at the end of August and beginning of September, the fruit is harvested with its' leaves, bud, and shoot. There is a great need for equipment to clean the early harvested fruit preserved in the cellar and the frozen fruit.

Research materials and methodology.

We conducted a test for refining the sea buckthorn from the waste matter and made the testing equipment. When the waste matter is sieved on the winnowing, the more significant waste stays on the winnowing then the fruit and smaller scraps fall to the bunker. The smaller chunks are cleaned by blowing with the propeller from the winnowing after that sea buckthorn goes outside through the funnel.

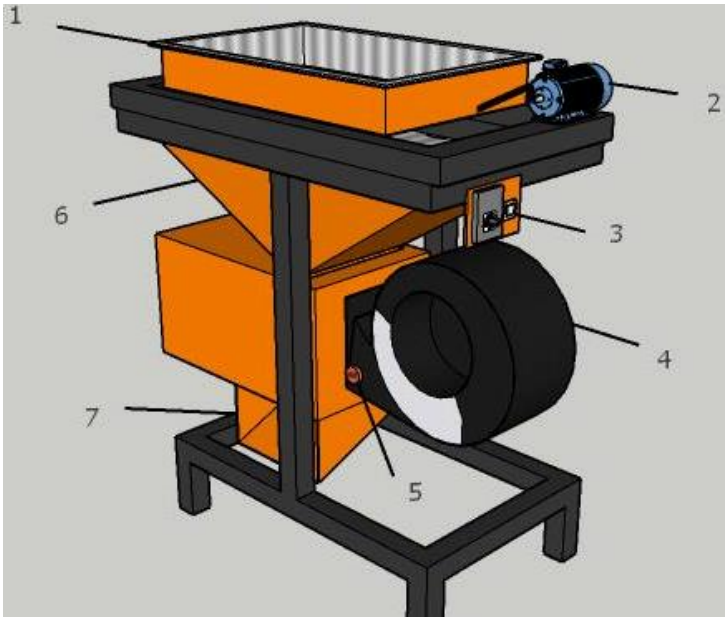

Fig. 1. The equipment for refining the sea buckthorn from the waste
1 – winnowing, 2 – the engine for managing the winnowing, 3 – the managing module of the equipment, 4 – the fan blows with the airflow, 5 – framework, 6 – bunker, 7 – fruit funnel

The number of the winnowing fluctuation will be run by the potentiometer that is installed in the managing module. But the airflow speed from the blowing fan will be regulated by the barricade installed in the wall. We defined the target function for estimating the main parameters of the testing equipment.

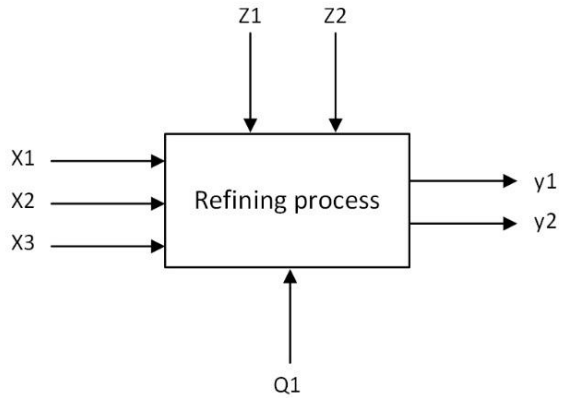

Fig. 2. Target function
Here: Input factor: x_1 – blowing fan speed; x_2 – winnowing fluctuation; x_3 – sea buckthorn weight; output factor y_1 – refining degree, %

$$y_1=f(x_1, x_2, x_3) \rightarrow max$$

The level of the factors expressing the *y* indicator will be defined not only by Xi_{max}, Xi_{min} but also in the 3rd and 5th levels or Boxing planning (e. g. 2nd stage rotatable planning) (Авдай.Ч, 2017). The relevant value of the input factors was pre-defined and shown in table 2.

Table 1. Testing criterion

Influencing factors	The changing parameters of the influencing factors					J_i
	$-x_a$	$x_{i\text{дооД}}$	x_{i0}	$x_{i\text{дээд}}$	$+x_a$	
	-1.682	-1	0	+1	+1.682	
Airflow speed X_1, m/s	9.372	10	11	12	12.68	1
Winnowing fluctuation, X_2,	76.59	80	85	90	93.41	5
Sea buckthorn weight, X_3, kg	2.812	3.5	4.5	5.5	6.182	1

Results of the Research.

We experimented by refining the sea buckthorn from the waste matter, and the result is shown in table 2.

Table 2. Experimentation matrix, results

№	Standard matrix			Work matrix			Output factor	
	Indicators			Quaesitum of the indicators				
	x_1	x_2	x_3	X_1	X_2	X_3	y_1	y_2
1	-	-	-	10	80	3.5	92.606	93.58
2	+	-	-	12	80	3.5	91.251	91.87
3	-	+	-	10	90	3.5	92.419	92.56
4	+	+	-	12	90	3.5	88.335	89.49
5	-	-	+	10	80	5.5	92.61	93.28
6	+	-	+	12	80	5.5	94.355	90.55
7	-	+	+	10	90	5.5	90.112	94.19
8	+	+	+	12	90	5.5	90.301	89.92
9	-1.682	0	0	9.372	85	4.5	89.32	91.63
10	+1.682	0	0	12.68	85	4.5	87.069	88.17
11	0	-1.682	0	11	76.59	4.5	89.235	90.38
12	0	+1.682	0	11	93.41	4.5	87.249	87.41
13	0	0	-1.682	11	85	2.812	94.279	90.82
14	0	0	+1.682	11	85	6.182	91.799	94.22
15	0	0	0	11	85	4.5	88.272	92.48
16	0	0	0	11	85	4.5	88.062	90.54
17	0	0	0	11	85	4.5	90.919	92.54
18	0	0	0	11	85	4.5	91.93	92.17
19	0	0	0	11	85	4.5	90.93	89.61
20	0	0	0	11	85	4.5	90.465	89.3

Shapiro and Wilka's W calculation value was $W_T = 16{,}63$ and the table value was $W_X = 0{,}96$. When we did the mathematical formulation conformed to the normal dispersion law, the calculation value of the Kohren G was $G_T = 0.13008$ and the table value was lower than $G_X = 0.3896$ - which means it has the same dispersion. We identified the regression coefficient that expressed a relation between the factors and modeled multiple correlations.

$$y = 90.425 - 0.911x_1 - 0.772x_2 + 1.143x_3^2 \quad (1)$$

The calculation value was $F_T = 1.9347$. When we checked the equation by the Fischer criterion, $F_T < F_X = 2{,}447$ then we confirmed that our modeling was the same.

$$x_1 = \frac{X_1 - 11}{1};\ x_2 = \frac{X_2 - 85}{5};\ x_3 = \frac{X_3 - 4.5}{1}$$

these parameters were replaced in the modeling and then we had the specific modeling.

$$y = 136.715 - 0.911X_1 - 0.1544X_2 - 10.287X_3 + 1.143X_3^2 \quad (2)$$

Image surface of the sea buckthorn refining degree:

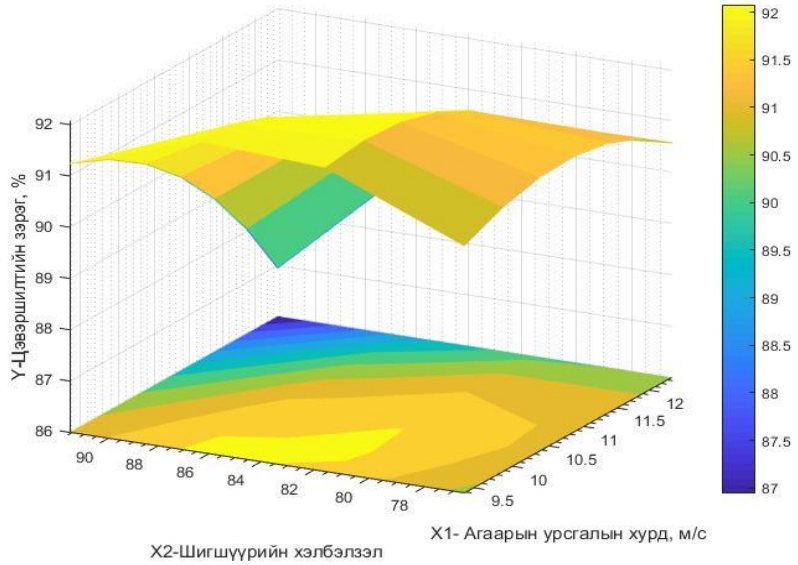

Fig. 3. The correlation graphic between winnowing fluctuation and airflow speed of sea buckthorn refining degree
$y = f(X1,\ X2)$

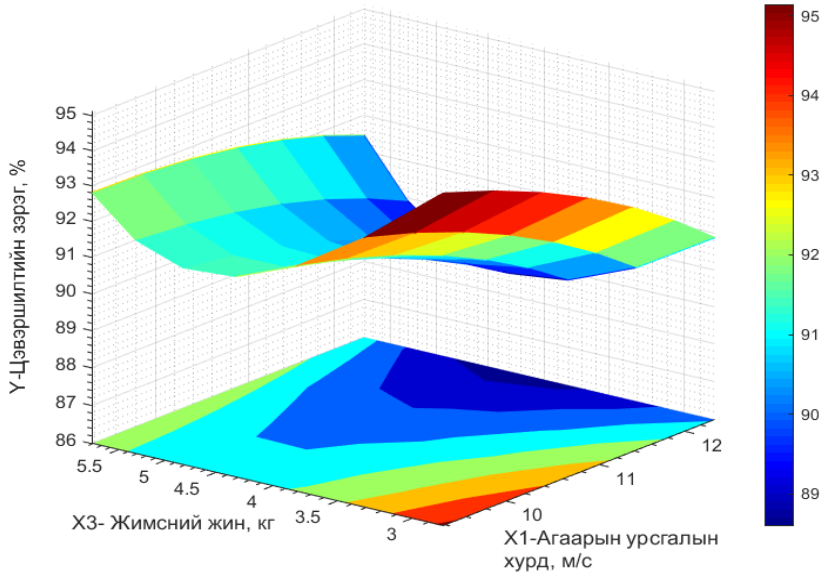

Fig. 4. The correlation graphic between fruit weight and airflow speed of sea buckthorn refining degree
$y = f(X1,\ X3)$

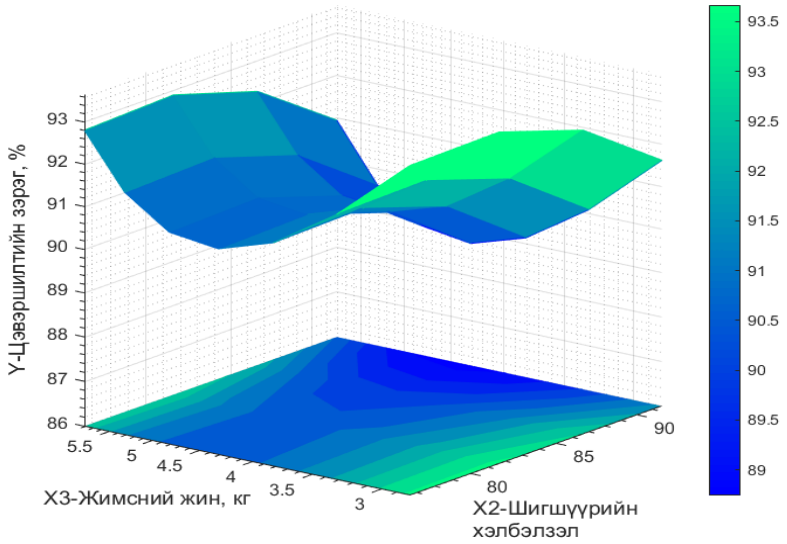

Fig. 5. The correlation graphic between the fruit weight and airflow speed of the sea buckthorn refining degree

$$y = f(X2,\ X3)$$

The optimal value of the input factor will be as follows when the output factor is calculated by step-by-step method then the highest value is 93.25 per cent.

Conclusions.

- The winnowing fluctuation and airflow speed influence on the fruit weight when sea buckthorn is cleaned from waste matters. The mathematic model of the refining degree of the sea buckthorn is as follows.

$$y = 136.715 - 0.911X_1 - 0.1544X_2 - 10.287X_3 + 1.143X_3^2$$

- The optimal value of the input factors of sea buckthorn refining or the fruit weight is 3.5kg, blowing fan speed is 10 m/sec, winnowing fluctuation is $80\,min^{-1}$, refining degree of the sea buckthorn is $y = 93.25$ %.
- The refining degree of the sea buckthorn is 93.25% and it meets the standard of technical requirement "*MNS0916:2011"*
- The electricity consumption of the equipment was $3.96\,kW\cdot$. The electricity payment will be 15500 tugrug when the equipment is run.

REFERENCES

1. Avdai, Ch. and Enkhtuya, D. (2019). Mathematical Methods of Experimental Planning and Its Application in Research Study. Ulaanbaatar, Mongolia: MUST Printing. p. 163-295.
2. Avdai.Ch, Nasanjargal.M, Chimed-Ochir.M, Tumurmunkh.G (2020). "The processing technology of the sea buck buckthorn".
3. Ч.Авдай (1990). "Научные основы динамики рабочих процессов и обоснование параметров машин для уборки ягод облепихи в природно – климатических условиях".
4. Balgan.B, Avdai.Ch, Laagan.B (1993). "Developing the technique and technology and mechanization of the sea buckthorn harvesting". Ulaanbaatar.
5. Chimed-Ochir.G, Avdai.Ch, Bat.S (1993). "Developing the technique and technology of the sea buckthorn industry".
6. Ninj.B (2019). "The scientific and technological basis of the fruit and horticulture farming in distinctive condition of Mongolia". Ulaanabaatar.
7. Baasansuren. P (2010). "Improving the design and technology of the device for detaching fuzz from the cashmere by airflow" Ulaanbaatar.
8. Namnan.T (2004). "Improving the design of the receiving knot of the combing machine" Ulaanbaatar.
9. Davaadorj.L (1998). "Choosing the optimal parameters of the small machine and studying the technological process of grain cleaning" Ulaanbaatar.