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A PRELIMINARY STUDY ON UNDERSTANDING THE CONSUMPTIONS OF THERAPEUTIC ESSENTIAL OILS DURING COVID-19 PANDEMIC AMONG ADULTS USING ANN

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ABSTRACT

The COVID-19 pandemic has emphasized the significance of utilizing essential oils (EO) as one of the holistic ways of supporting and enhancing health. As a consequence of growing knowledge of connected health concerns, people all over the world are looking for natural ways to avoid different ailments. It has been proven that excellent health and psychological awareness increase the human body's immune response, therefore boosting disease resistance. Essential oils are derived in a number

of ways from valued plants containing active chemicals with medicinal qualities. In Malaysia, many have used EO in their daily lives. This paper identifies the hierarchy of importance among factors which contribute towards the usage frequency of essential oils in Malaysia using an artificial neural network. Two-layer neural network (NN) models have been applied, which are multilayer perceptron (MLP) and radial basis function (RBF). Based on the analysis done, RBF-NN performed the best with SSE=4.436 and RE=0.548. It can be concluded that, based on sensitivity analysis, the top five factors toward usage frequency are consumption, age, external use, clinic visit, and occasion, with normalized importance of 100%, 90.8%, 89.3%, 68.2%, and 42.2% respectively.

Keywords: Consumption, therapeutic essential oils, COVID-19, adults, artificial neural network

INTRODUCTION

The COVID-19 pandemic highlighted the importance of using Essential Oils (EO) as one of the holistic approaches in promoting and improving health. Nowadays, people all around the world are seeking for natural solutions to prevent various illnesses as a result of increased awareness regarding related health issues. It has been demonstrated that good health and psychological awareness boost the immunological response of the human body, hence increasing disease resistance (Al-Mansour & Adraa, 2020). Essential oils are extracted from valuable plants in a variety of ways and contain active compounds that have therapeutic properties (Fung et al., 2021). Aromatherapy is an alternative medicinal method that involves the therapeutic use of essential oils that could lead to effective treatment options for diseases (Al-Mansour & Adraa, 2020). The expanding and widespread use of complementary and alternative medicine in the treatment of symptoms of both physical and mental problems in Western countries has been extensively observed (van der Watt, & Janca, 2008). A study by Mazlan and Diah (2017), showed that despite the lack of clinical evidence for EO's usefulness, it is widely used among Malaysians to maintain their emotional well-being. EOs have been gaining scientific attention due to high potential as a cough and flu preventive agent, wound healing or skin irritation relief, and stress relief (Fung et al., 2021; Avola et al., 2020).

COVID-19 frequently affects the upper respiratory tract, and the majority of patients are treated at home with a mild-to-moderate form of the virus (Valussi et al., 2021). Antiviral properties of EOs have been demonstrated against a variety of harmful viruses. EO components may interact with major protein targets of the 2019 severe acute respiratory syndrome coronavirus 2 (SARSCoV2). Current research by Panikar et al. (2021), which tested on molecular docking of seven components of EOs (citronellol, alpha-terpineol, eucalyptol, D-limonene, 3-carene, o-cymene, and alpha-pinene) showed that the binding energy, hydrophobic contacts, and hydrogen bond interactions of 6LU7 (Mpro) with Eucalyptus and Corymbia volatile secondary compounds indicated its potential as a potential Covid-19 treatment solution.

The application of Artificial Neural Network (ANN) in aromatherapy using EOs has been well established (Acimovic et al., 2021). According to Niazian et al. (2021), ANN performs better than MLR with an RMSE of 0.262 and an R2 of 0.748. Bahmani et al. (2018) used the ANN model to predict kinetics of EO extraction from tarragon (Artemisia dracunculus L.) using ultrasound pre-treatment with Clevenger.

LITERATURE REVIEW

Essential oils can be used in a variety of ways including diffusion, oral administration, inhalation, and massage. According to Seyyed-Rasooli et al. (2016), aromatherapy massage and inhalation aromatherapy have a positive effect in comparison to a control group to reduce both anxiety and pain in burn patients. Takeda et al. (2017) suggested that inhalation aromatherapy has a good influence on sleep disruption symptoms in dementia patients. A study by Donatello et al. (2020) discovered that

inhaling LaEO lowers mechanical hyperalgesia in chronic inflammatory and neuropathic pain. The olfactory receptor cells in the nasal epithelium, which number roughly 25 million and are associated to the olfactory bulb, are triggered by EOs provided through inhalation aromatherapy (Sandez-Vidana et al., 2017).

Several essential oils with their therapeutic effect

Based on the existence of various active components, different EOs will have unique therapeutic effects (Table 1). A study by Gismondi et al., (2021) demonstrated that Lavender EO reduces the amount of bacteria in all hospital areas and this trend was even significant in some situations. A study by Sentral et al. (2020) found that citronellol and limonene treatment significantly reduced ACE2 expression in epithelial cells, which indicates a potential to have antiviral properties. Geranium and lemon oils have significant ACE2 inhibitory actions, according to immunoblotting and qPCR analyses. The use of EOs with increased antibacterial activity in Staphylococcus aureus causes biofilm formation during the early adhesion phase, which has been shown to occur in Patchouli and ylang-ylang EOs (Bilcu et al., 2014). Furthermore, there are a few EOs that are linked to human emotional stability. A study by Fung et al. (2021) reported that EO molecules may reach the brain and exert an effect by two separate mechanisms, namely the olfactory system and the respiratory system. According to Moeini and Khadibi, (2011), lavender oil aromatherapy reduces sleep disturbances and improved sleep quality in IHD patients in the CCU.

Table 1

Several different essential oils and their therapeutic effect

Common names	Scientific name	Benefits	Authors
Bergamot	*Citrus bergamia*	To improve participants' positive feelings	Han et al. (2017)
		Can improve anxiety symptom	Cui et al. (2020)
Lavendar	*Lavandula angustifolia*	Anti-inflammatory	Donatello et al. (2020)
		Anti-bacterial	Gismondi et al. (2021)
Citronella	*Cymbopogon nardus*	Can be applied as natural mouthwash, because if its low cytotoxicity and higher antimicrobial activity	Cunha et al. (2020)
Cinnamon	*Cinnamon zeylanicum*	Anti-proliferative, antimicrobial and antioxidant	Alizadeh Behbahani et al. (2020)
Lemon	*Citrus lemon*	Food preservatives, antimicrobial agent	Yazgan et al. (2019)
		Antiviral	Senthil et al. (2020)
Ylang ylang	*Cananga odorata*	Decreased blood pressure	Jung et al. (2013)
		Reduced stress and effectively prevent suicide	Amadéo et al. (2020)
		Inhibit bacterial activity	Bilcu et al. (2014)
Cedarwood	*Cedrus atlantica*	Antioxidant and antibacterial abilities	Huang et al. (2021)
Thyme	*Thymus vulgaris*	Antioxidant substances that help to improve the immune system as well as antiviral properties that help to relieve respiratory symptoms	Sardari et al. (2021)
Geranium	*Pelargonium graveolens*	Antiviral	Senthil et al. (2020)

METHODOLOGY

Random sample of n=50 was chosen among EO users in Malaysia and a questionnaire has been constructed and distributed to these selected respondents. This EO dataset was analyzed using artificial neural network methods, specifically (1) multilayer perceptron neural network (MLP-NN) and (2) radial basis function neural network (RBF-NN). The flowchart of this research can be seen in Figure 1.

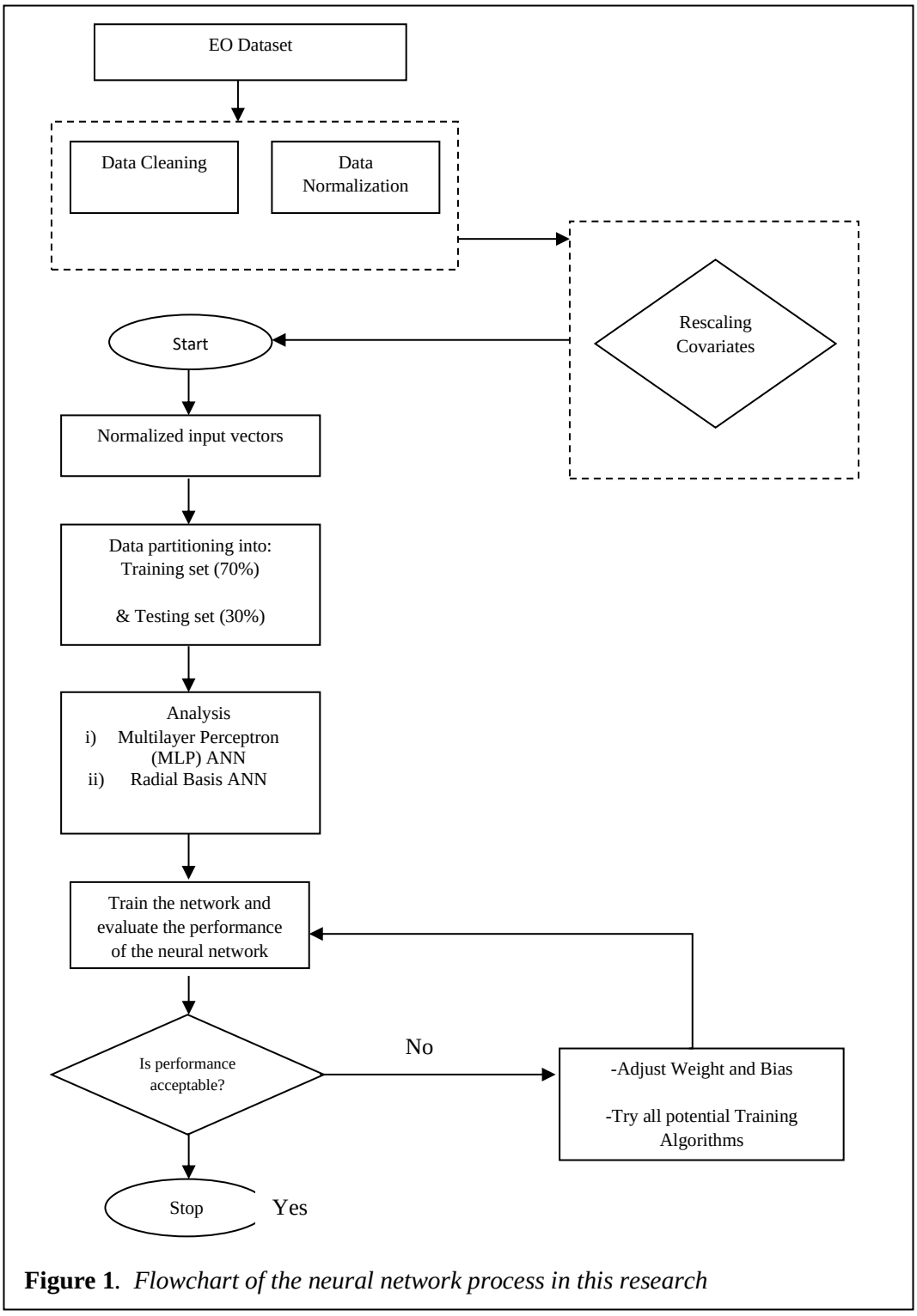

Figure 1. *Flowchart of the neural network process in this research*

RESULT AND DISCUSSION

In this research, the Artificial Neural Network of Multilayer Perceptron (ANN-MLP) model was used. SPSS 23 was used to perform the ANN. The two-layer neural network was modified with the hyperbolic tangent transfer function in the first layer and the purelin transfer function in the second layer. Hyperbolic tangent was utilised as the training function in this study, with a mean square error (MSE) of 0.0 as the criteria function. As shown in Table 2, the theoretical structure consists of two variables: independent and dependent variables.

Table 2

Variables involved in this research

Type of variable	Notation	Description
Independent	X1	Age
	X2	Gender
	X3	Occupation
	X4	Working Sector
	X5	Period of Use
	X6	Introducer
	X7	Critical Illness
	X8	External Use
	X9	Consumption
	X10	Minor injuries
	X11	Stress
	X12	Occasion
	X13	Anxiety
	X14	Clinic Visit
	X15	Changes to Self and Family
Dependent	Y	Frequency of EO Use

Figure 2 and Figure 4 show the neural network architecture for both MLP-NN and RBF-NN models respectively. The best configuration for MLP-NN was 15-2-1, while for RBF-NN it was 15-7-1. The performances of both models can be referred to in Table 3 and Table 6. Based on sum of squared error (SSE) values of testing sets for both models, RBF-NN model performed better with less errors (SSE=4.436), while MLP-NN model produced greater errors with SSE=5.901. Table 4 and Table 7 show the parameter estimates of both models.

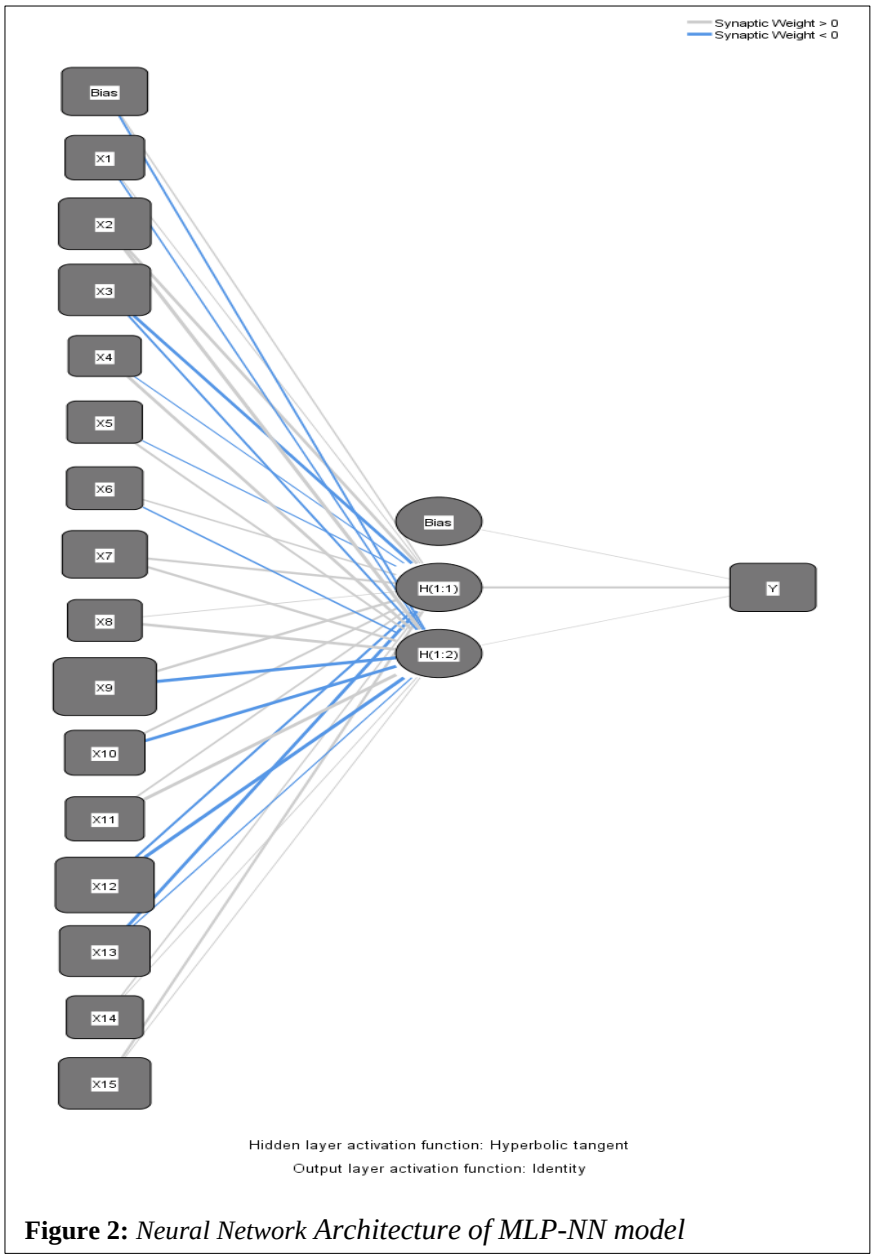

Figure 2: *Neural Network Architecture of MLP-NN model*

Table 3

Model Summary of MLP-NN model

Training	Sum of Squares Error	22.548
	Relative Error	1.025
	Stopping Rule Used	1 consecutive step(s) with no decrease in error[a]
	Training Time	0:00:00.02
Testing	Sum of Squares Error	5.901
	Relative Error	.928
Dependent Variable: Frequency of using EO		
a. Error computations are based on the testing sample.		

Table 4.

Parameter Estimates of MLP-NN model

		Predicted		
		Hidden Layer 1		Output Layer
Predictor		H(1:1)	H(1:2)	Y
Input Layer	(Bias)	.118	-.149	
	X1	.085	-.130	
	X2	.328	.404	
	X3	-.351	-.161	
	X4	-.090	.340	
	X5	-.093	.181	
	X6	.140	-.139	
	X7	.250	.262	
	X8	.030	.403	
	X9	.277	-.475	
	X10	.200	-.423	
	X11	.144	.410	
	X12	-.220	-.464	
	X13	-.372	-.094	
	X14	.097	.055	
	X15	.249	.078	
Hidden Layer 1	(Bias)			.021
	H(1:1)			.249
	H(1:2)			.014

Table 5 Independent Variable Importance of MLP-NN model

	Importance	Normalized Importance
X1	.045	30.7%
X2	.099	68.1%
X3	.097	66.6%
X4	.017	12.0%
X5	.028	19.0%
X6	.032	21.8%
X7	.068	46.9%
X8	.024	16.7%
X9	.146	100.0%
X10	.049	33.4%
X11	.042	28.8%
X12	.128	87.6%
X13	.093	63.4%
X14	.034	23.0%
X15	.098	67.4%

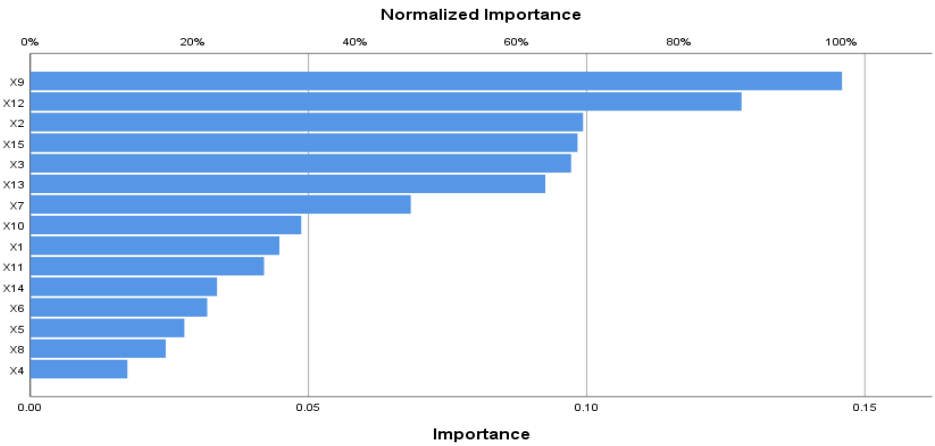

Figure 3. *Normalized Importance of MLP-NN model*

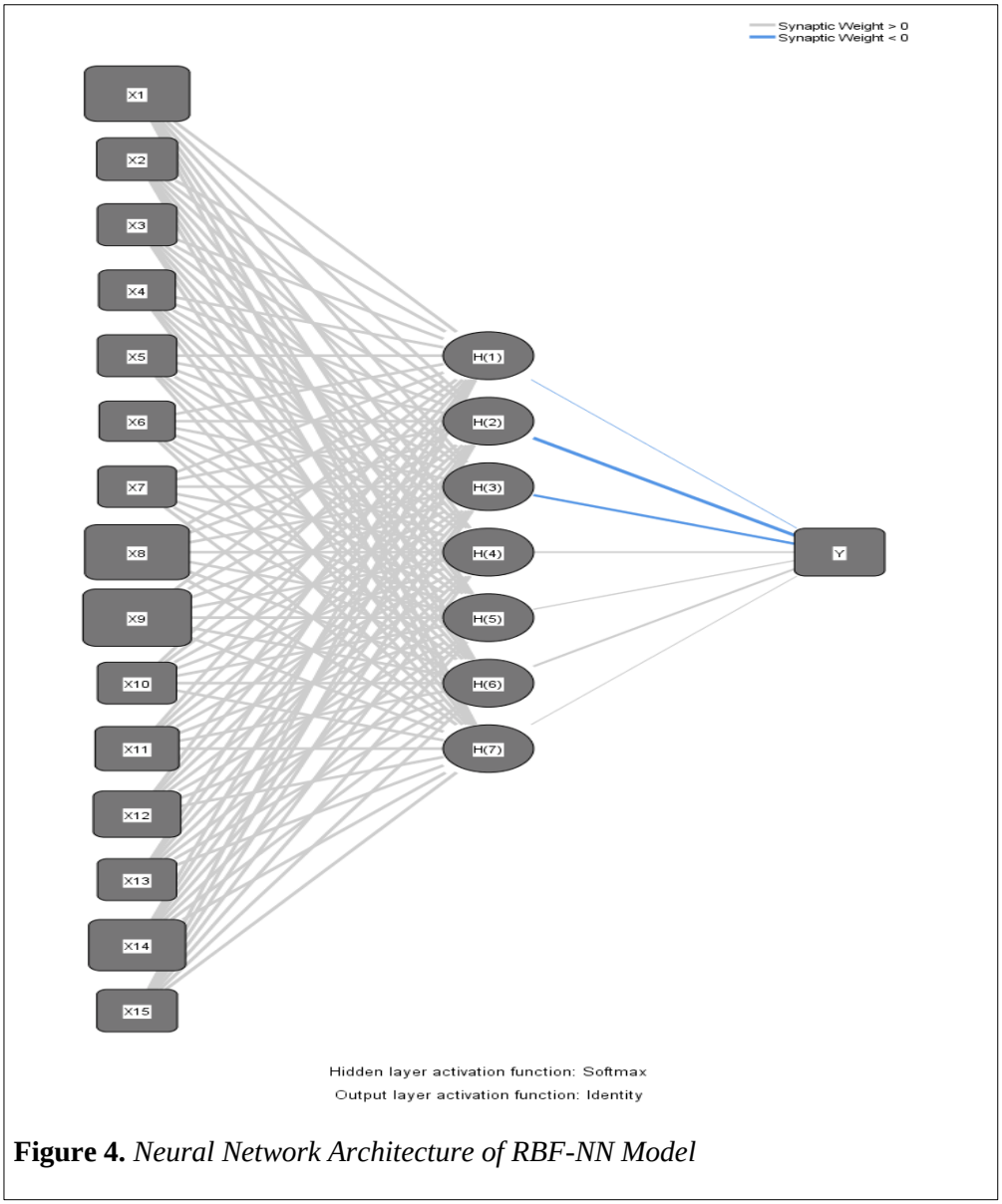

Figure 4. *Neural Network Architecture of RBF-NN Model*

Table 6

Model Summary of RBF-NN Model

Training	Sum of Squares Error	13.960
	Relative Error	.716
	Training Time	0:00:00.03
Testing	Sum of Squares Error	4.436[a]
	Relative Error	.548

Dependent Variable: Frequency of using EO
a. The number of hidden units is determined by the testing data criterion: The "best" number of hidden units is the one that yields the smallest error in the testing data.

Table 7

Parameter Estimates of RBF-NN Model

		Predicted							
		Hidden Layer[a]							Output Layer
Predictor		H(1)	H(2)	H(3)	H(4)	H(5)	H(6)	H(7)	Y
Input Layer	X1	-.372	-.232	-1.916	.295	.400	.190	-.051	
	X2	-1.710	-2.220E-16	.570	.570	-1.110E-16	.570	.570	
	X3	-.661	.690	-.407	-.646	-.381	-.690	1.777	
	X4	.156	.120	-.860	.156	-.691	1.173	.882	
	X5	-.239	-.113	-1.246	.830	-.239	-1.246	.264	
	X6	-1.214	.203	1.009	-.299	.615	.005	-.077	
	X7	-.138	-.532	.650	-.532	.256	1.833	.144	
	X8	.158	.158	.158	.158	.158	-6.166	.158	
	X9	.161	-.380	-3.176	.270	.216	.270	.270	
	X10	.494	-1.358	.494	-.432	.494	-1.975	.141	
	X11	.246	-1.602	-1.602	.587	.246	.616	-.018	
	X12	-.292	-.056	.429	-.317	.217	1.398	-.051	
	X13	.171	-1.826	.321	.539	.150	.571	-.150	
	X14	-.025	-1.720	-2.344	.403	.415	.439	.439	
	X15	.387	1.684	-.831	.618	-.599	-.117	-.719	
Hidden Unit Width		1.175	1.278	2.172	1.076	1.111	1.076	1.345	
Hidden Layer	H(1)								-.279
	H(2)								-1.080
	H(3)								-.996
	H(4)								.688
	H(5)								.516
	H(6)								.705
	H(7)								.471

Table 8

Independent Variable Importance of RBF-NN Model

	Importance	Normalized Importance
X1	.155	90.8%
X2	.041	23.8%
X3	.035	20.2%
X4	.021	12.1%
X5	.033	19.5%
X6	.017	9.9%
X7	.029	16.7%
X8	.153	89.3%
X9	.171	100.0%
X10	.032	18.8%
X11	.055	32.1%
X12	.072	42.2%
X13	.032	19.0%
X14	.116	68.2%
X15	.039	22.7%

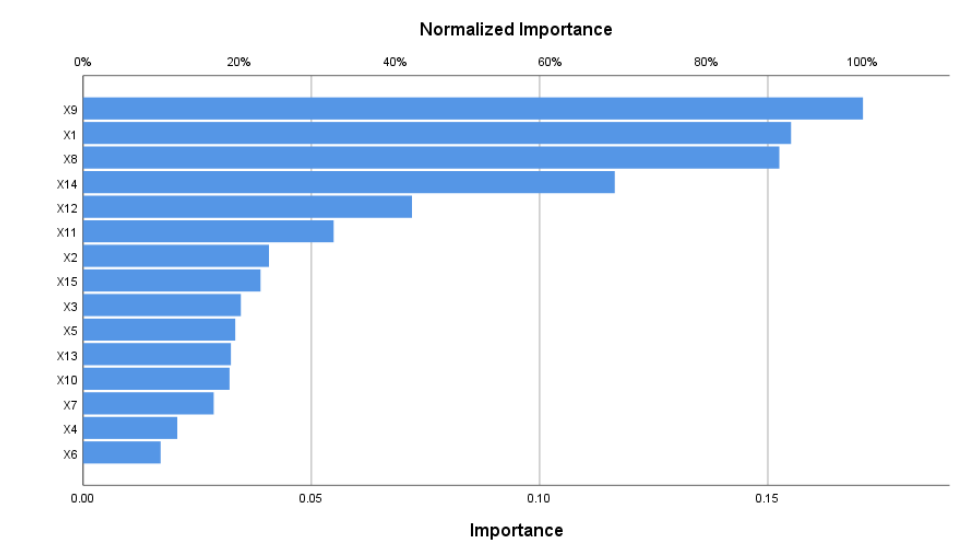

Figure 5. *Normalized Importance of RBF-NN Model*

Table 5 and Table 8 shows the normalized importance of each predictor towards the dependent variable in terms of percentages. Figure 3 has been produced from the results in Table 5, while Figure 5 has been produced from the results in Table 8. Based on the best model, which was RBF-NN, the top five factors toward EO usage frequency are consumption, age, external use, clinic visit, and occasion, with normalized importance of 100%, 90.8%, 89.3%, 68.2%, and 42.2% respectively. EO

companies can use this information resulting from this research to further strategize their business efforts accordingly.

CONCLUSION

In this research, it has been found that radial basis function neural network performed the best for the EO dataset. Two-layer neural network (NN) models have been applied, which are multilayer perceptron (MLP) and radial basis function (RBF) (RBF). Based on the analysis done, RBF-NN performed the best with SSE=4.436 and RE=0.548. It can be concluded that, based on sensitivity analysis, the top five factors toward usage frequency are consumption, age, external use, clinic visit, and occasion, with normalized importance of 100%, 90.8%, 89.3%, 68.2%, and 42.2% respectively. Diffusion, oral administration, inhalation, and massage are all ways to use essential oils. In comparison to the control group, aromatherapy massage and inhalation aromatherapy have a positive effect on reducing both anxiety and pain in burn patients. Inhalation aromatherapy has a good influence on sleep disruption symptoms in dementia patients. Inhaling EO lowers mechanical hyperalgesia in chronic inflammatory and neuropathic pain patients. The olfactory receptor cells in the nasal epithelium, which number roughly 25 million and are associated to the olfactory bulb, are triggered by essential oils provided through inhalation aromatherapy.

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