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Comparative Study of Effect of Weight, Time and Temperature on Extracted Oil Recovered from Some Mango Seed

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RESEARCH ARTICLE

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ABSTRACT

This research was used to evaluate and characterised the product obtained from a unique process called mechanothermal extraction/distillation process of 3 mango seeds materials (opioro, Enugu and Benue Species) of 3 species each for the production of oil. The oil obtained from the process will serve as raw materials and be useful in the following areas: Pharmaceutical, chemical and food processing industries respectively. The quality and quantity of the oil produced was analysed and the obtained results were attributed to the species of the raw materials used in the extraction /distillation processes. The research reveals the species of mango seeds of 3 species (opioro, Enugu and Benue Species), The functional parameters analysed for the purpose of determining its properties include refractive index, density, viscosity, iodine value, peroxide value, saponification values, freefatty acid, proximate, Broactive properties and glycerine compositions for chemical and food processing industries. The refractive index determination of the 3 species of mango seeds oil showed as Enugu Species: 1.3728; Opioro Species 1.34827 and Benue Species 1.34431. The other results for 3 species of Mango Seeds showed density Enugu 1.1072, Opioro 1.34827 and Benue 1.34431g/cc. Viscosity Enugu 0.1995cst, Opioro 2.282cst and Benue 2.149cst. Iodine Value Enugu 13.70, Opioro 13.201 and Benue 16.62. Saponification value Enugu 18.513, Opioro 17.111 and Benue 8.35% Free fatty acid enugu 32.26, Opioro 25.86% and Benue 18.69%. Peroxide value Enugu 80.01, Opioro 85.0, and Benue 40.0% Acid value Enugu 1.46, Oporo 1.35 and Benue 0.982%.

Key words: Comparative, effect, weight, time, temperature, oil, mango, seed

INTRODUCTION

Mango (Mangifera indica) which is known as mangifer Indica is a member of the Anacardiaceae family, namely from the genus [1-4]. Mangifera indica is believed to have originated in tropical and subtropical regions of Asia and Africa, as shown by study findings. The perennial evergreen arbour is a tree with branches that may reach a height of 5 to 20 metres [5]. Branches give rise to the growth of fruits and leaves. Over the last several decades, many different types of mangoes, such as Golers Chokanah MA224 and Masmuda MA204, have been grown [6]. Mangifera Indica Malt2 is often found in local markets and typically has medium-sized fruit weighing between 100 and 300 grammes [7]. The apple is visually appealing with its vibrant orange colour and robust texture, complemented by its fresh green appearance. It is considered one of the finest fruits in the world. The green and yellow mango is considered to be a rich source of fibre, riboflavin, and carotene [8-10]. It is a great source of ascorbic acid and a significant source of calcium, iron, odellin, pantothenic acid, niacin, and vitamin [11]. Due to its short growing season and great profitability, this fruit crop has a significant economic effect. However, its export potential is limited, and it is mostly sold in local markets due to storage constraints [12].

The mango seed makes up a substantial proportion of the fruit's weight, accounting for between 30 to 45%. This results in a huge quantity of waste from mango processing facilities. Mango seeds has the capacity to provide oil with nutritional and functional qualities that closely resemble those of olive oil, ranging from 40 to 80% in quantity. Previous research has not yet proved the consumability of mango seed oil. In addition, the sarcotesta of the seed has a high concentration of amino acids, namely about 20.5%. Furthermore, the seed also contains a significant amount of fiber [13]. The mango seed oil is a fluid substance that has a pale yellow hue. The oil is believed to have the potential to be used for both culinary and industrial purposes due to its composition of palmitic acid, oleic acid, and linoleic acid. In addition, Mango, scientifically known as Mangifera indica L., belongs to the Anacardiaceous family. Mango has undergone naturalization and adaptation in tropical and subtropical regions. There are more than 500 categorized mango cultivars, a portion of which have undergone evolutionary changes and have been

documented worldwide. The Mangifera genus has 69 species and is mostly found in tropical Asia. Malaysia, namely the peninsular area, is home to the greatest diversity of mangoes, with around 28 species found in this region. Malaysia cultivates many types of mango, including the well-known Golek (MA 162), Masmuda (MA 204), Maha 65 (MA 165), and Chok Anan (MA 224) [14-15]. The domestic consumption saw a significant growth from 42,634 metric tonnes in 2007 to 55,901 metric tonnes in 2022. The substantial rise in mango consumption in residential settings has resulted in the buildup of trash. The mango seed kernel is often discarded during processing.

MATERIALS AND METHODS

Materials

Mature mango, Avocado and native pear fruits of different species were bought from fruit garden in Port Harcourt city. The fruits were cut into two longitudinal halves and seeds removed by hand. The seeds were cleaned by squeezing the seeds with hand and then allowed to dry for 3 days in a digital mermet oven at 35^{o}C in the unit operation laboratory Chemical/Petrochemical Engineering Department Rivers State University Nkpolu-Oroworukwo Port Harcourt. After drying, the seeds were grinded using a crushing machine, while grinding, the cake of the various seeds were moist with 250 milliliters of distilled water to 500g of the seeds to form slurry. After the slurry stage, an extracting machine was used to separate the liquid slurry from the cake. The liquid slurry was introduced into the first distillation flask fixed on the first heating mantle connected with condenser and glass tubings with glass adaptor/corks. Extraction processes was carried out in batches at different temperatures of 50 ^{o}C,55 ^{o}C,60 ^{o}C,65 ^{o}C,70 ^{o}C,and 75^{o}C using MECHANO THERMAL distillation/extraction processes. During this first stage, the moisture content and the oil in the seeds is transported to the second flask that was fixed in another heating mantle through the glass tubings. The second stage of distillation/Extraction processes which is called recovery stage, the distillation was carried out at the temperatures of 45 ^{o}C,50 ^{o}C.55 ^{o}C,60 ^{o}C,65 ^{o}C and 70 ^{o}C. Condenser, glass tubings/cork was also connected to distillation flask with outlet connected from the top of the distillation flask cork to the receiving flask where the pure oil is received. In this second stage, the moisture content in the oil is separated from the pure oil at different temperatures, time and concentrations by mass. The entire

processes went on simultaneously. A trial soxhlet solvent extraction process was also carried out using hexane as solvent which was compared with that of mechano-thermal process which was carried out without any solvent with respect to oil recovery

Methods

Mechano-thermal Extraction Method

Mechano-thermal extraction/distillation is a modern innovation process of extracting oil from agro seed material using crushing and extraction machines to grind and extract the lipid/moisture of seed and also applying heat in the process to recover pure oil without using solvent.(***Mechno-- use of mechanical approach for grind and extracting lipid/moisture from agro seed, while Thermal-- indicate the use of in extracting the pure product"oil"***) A total of 500g of the dry samples of Mango seeds was weighed from 3 different species, a total of 324 samples was measured out and placed individually in distillation flask. Each species had 36 samples for the extraction process. Each of the measured sample was poured into the low temperature extractor and extracted at 30 ^{o}C at the regulated time. The extracted juice was poured into the distillation flash. Heat was then applied to the flask containing the sample to be distilled/Extracted at the temperatures of 45^{o}C, 50 ^{o}C, 55 ^{o}C, 60, 65 and 70 ^{o}C. Each process took a particular time duration which was recorded for the 324 samples. The temperature was varied / fixed in order to get its effect on the samples oil yield. The extraction process goes simultaneously with distillation. The mechano-thermal process is unique hence it does not require solvent. This made it possible to trap pure/original oil with different concentration as the samples and species varies. There was continuous flow of cold water through the attached condenser in order to condense the extract and also get an effective extraction process. The yield of oil was determined by measuring the volume of the extract on an electronic using measuring cylinder. Subsequently, analysis and characterizations were carried out using GC-MS and HPLC Techniques, other instruments for physical/chemical properties.

RESULTS AND DISCUSSION

The results from this research are presented in Figures as demonstrated below upon the effect of weight, operational time and operational temperature as related and compared in the showcased Figures.

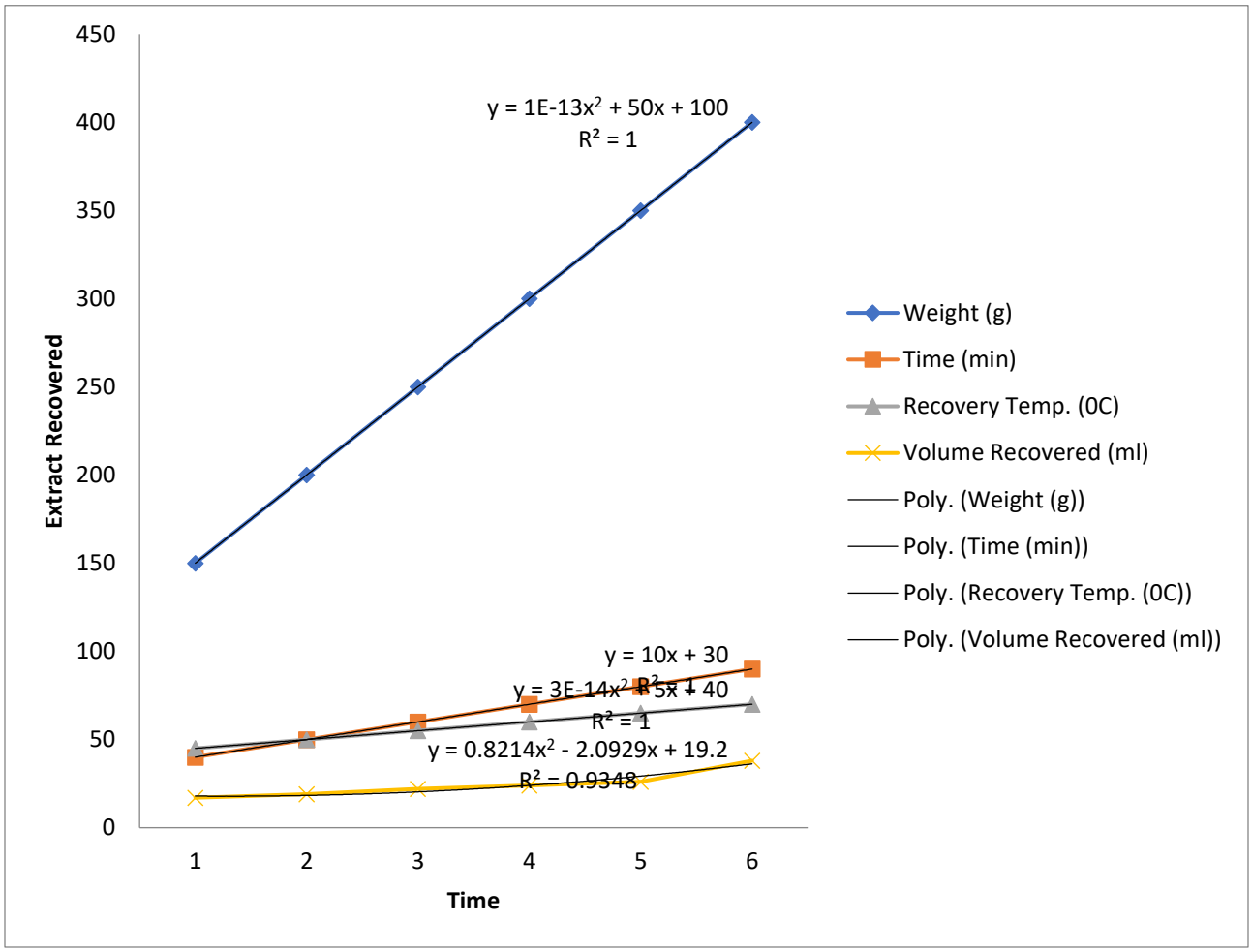

Figure 1: Graph of Oil from Mango Seed Extract Recovered in Terms of Varied Weight, Time and Temperature Condition for Enugu Specie

Figure 1 shows the relationship between the functional parameters of Mango seeds oil Enugu Species. Figure 1 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Enugu specie. It was seen that the functional parameter of extract recovered varied with weight, time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 150g to 400g (dosage) when the concerntration(dosage) is varied. All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it rising and a gradual decrease as the time of extraction increases. The variation in the volume of extract recovered can be attributed to variation in weight (concentration) charged

and significant effect of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as $y = 0.8214x^2 - 2.0929x + 19.2$ and square root of the best fit is given as $R^2 = 0.9848$. All the functional parameters have its square root as R^2=1.

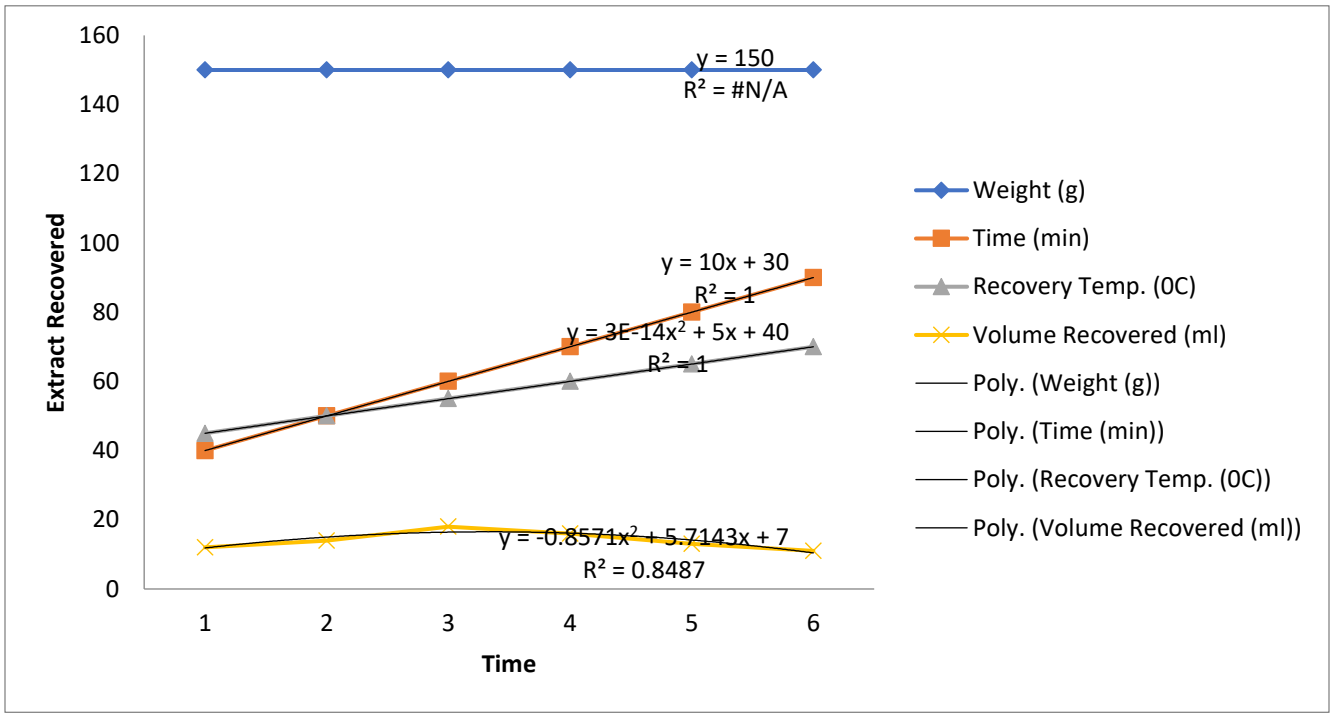

Figure 2: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 150g Upon the Influence of Time and Temperature Condition for Enugu Specie

Figure 2 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Enugu specie at a constant weight of 150g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve

for oil recovered in mango seed oil Bacon specie is given as $y = 10x^2 + 30x$ and square root of the best fit is given as $R^2 = 0.8487$. All the functional parameters have its square root as R^2=1.

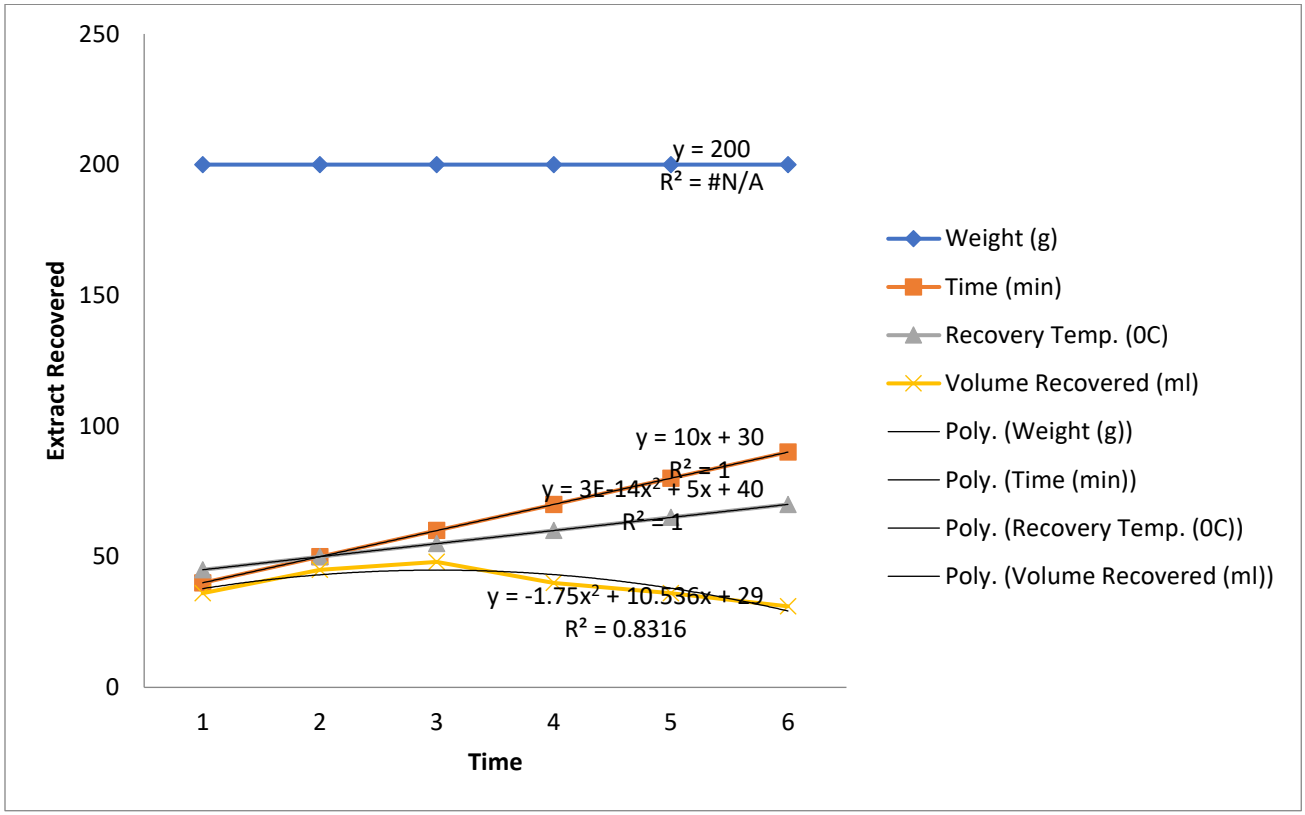

Figure 3: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 200g Upon the Influence of Time and Temperature Condition for Enugu Specie

Figure 3 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Enugu specie at a constant weight of 200g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve

for oil recovered in mango seed oil Bacon specie is given as $y = 10x^2 + 30x$ and square root of the best fit is given as $R^2 = 0.8316$. All the functional parameters have its square root as R^2=1.

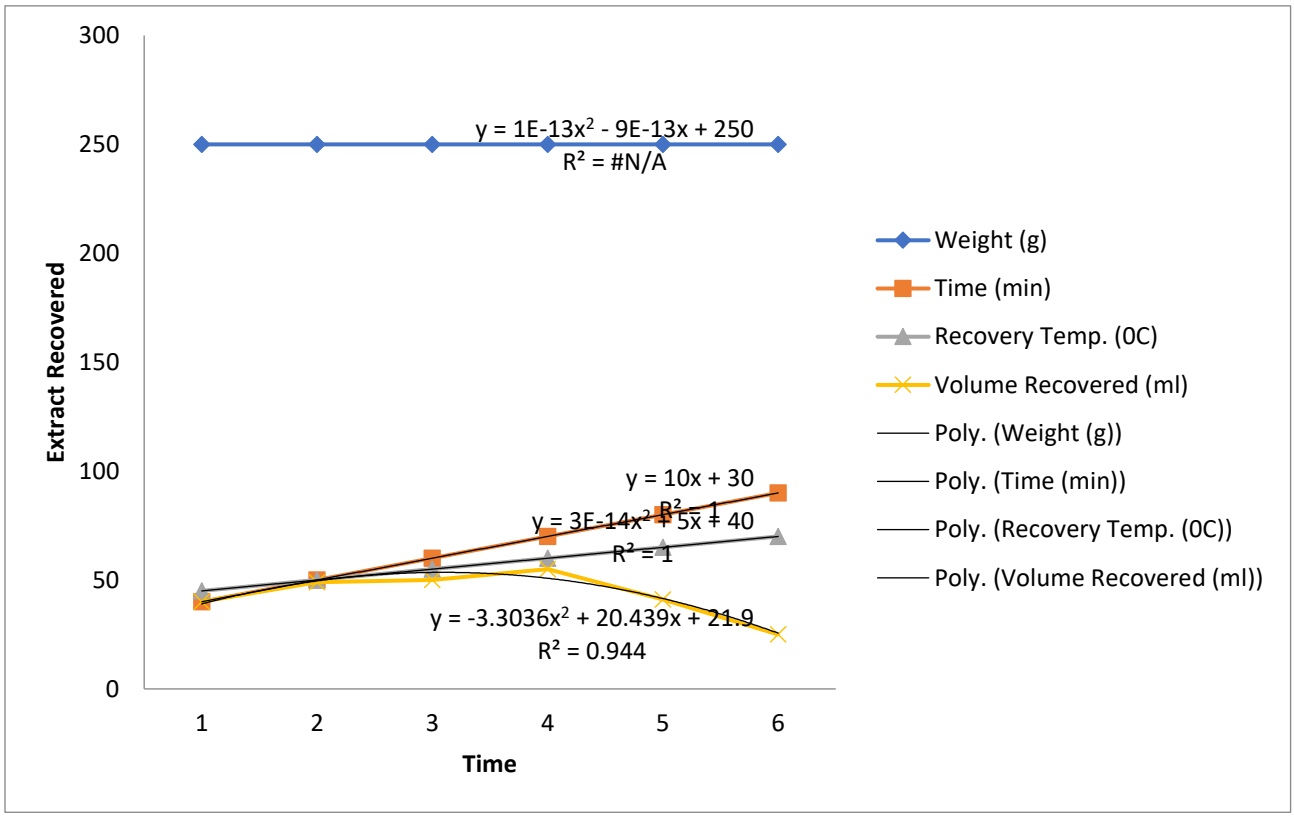

Figure 4: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 250g Upon the Influence of Time and Temperature Condition for Enugu Specie

Figure 4 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Enugu specie at a constant weight of 200g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve

for oil recovered in mango seed oil Bacon specie is given as $y = 10x^2 + 30x$ and square root of the best fit is given as $R^2 = 0.944$. All the functional parameters have its square root as R^2=1.

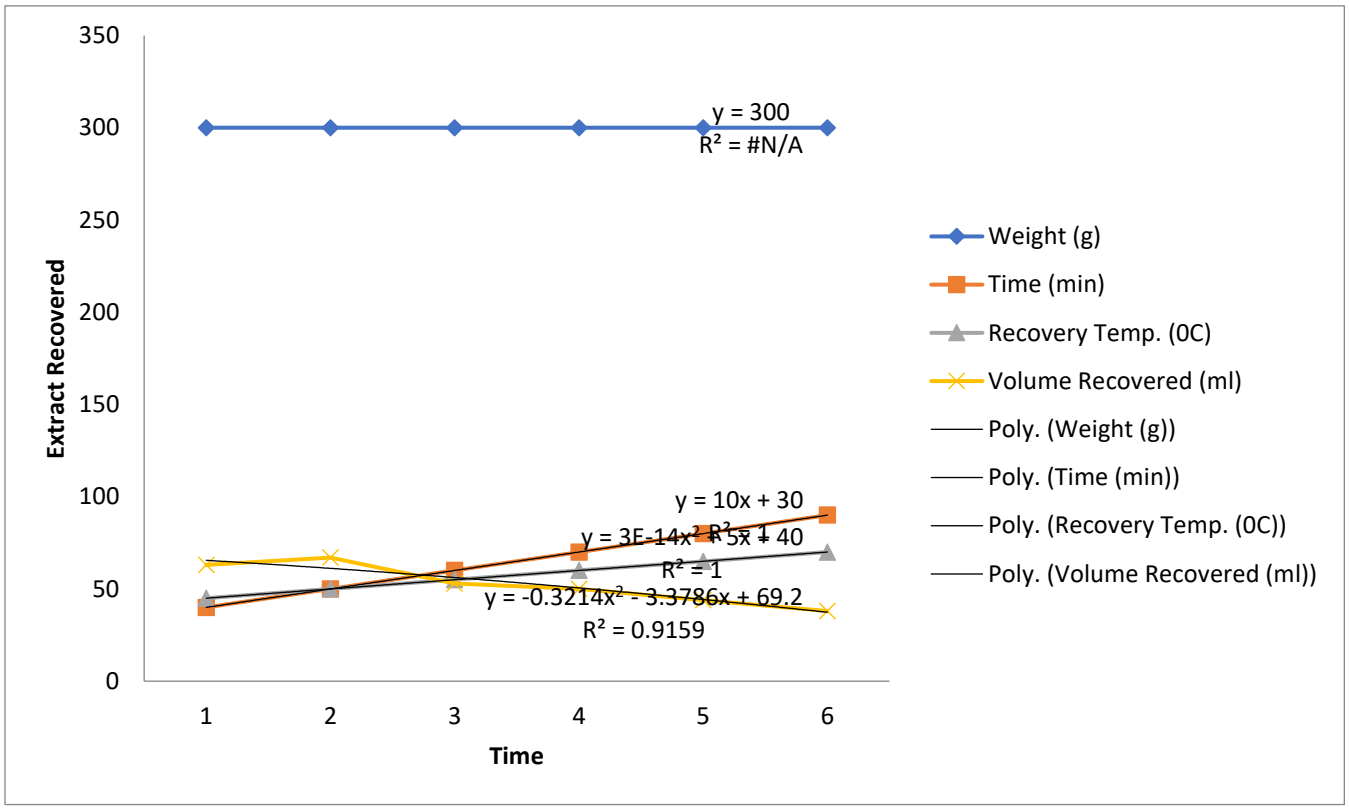

Figure 5: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 300g Upon the Influence of Time and Temperature Condition for Enugu Specie

Figure 5 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Enugu specie at a constant weight of 300g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve

for oil recovered in mango seed oil Bacon specie is given as $y = 10x^2 + 30x$ and square root of the best fit is given as $R^2 = 0.9159$. All the functional parameters have its square root as R^2=1.

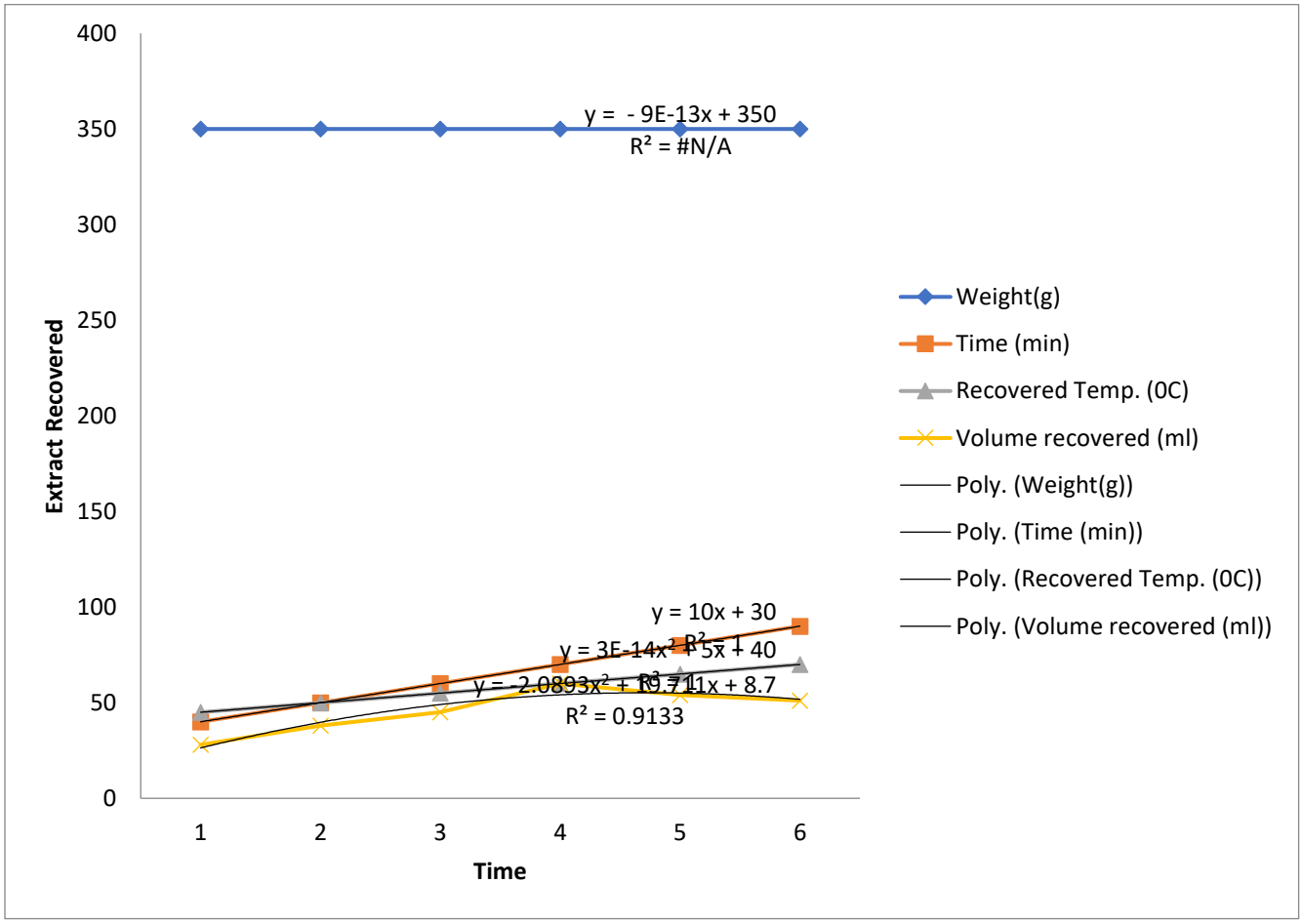

Figure 6: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 350g Upon the Influence of Time and Temperature Condition for Enugu Specie

Figure 6 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Enugu specie at a constant weight of 350g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered

can be attributed to variation in significant effect of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as $y = 10x^2 + 30x$ and square root of the best fit is given as $R^2 = 0.9133$. All the functional parameters have its square root as R^2=1.

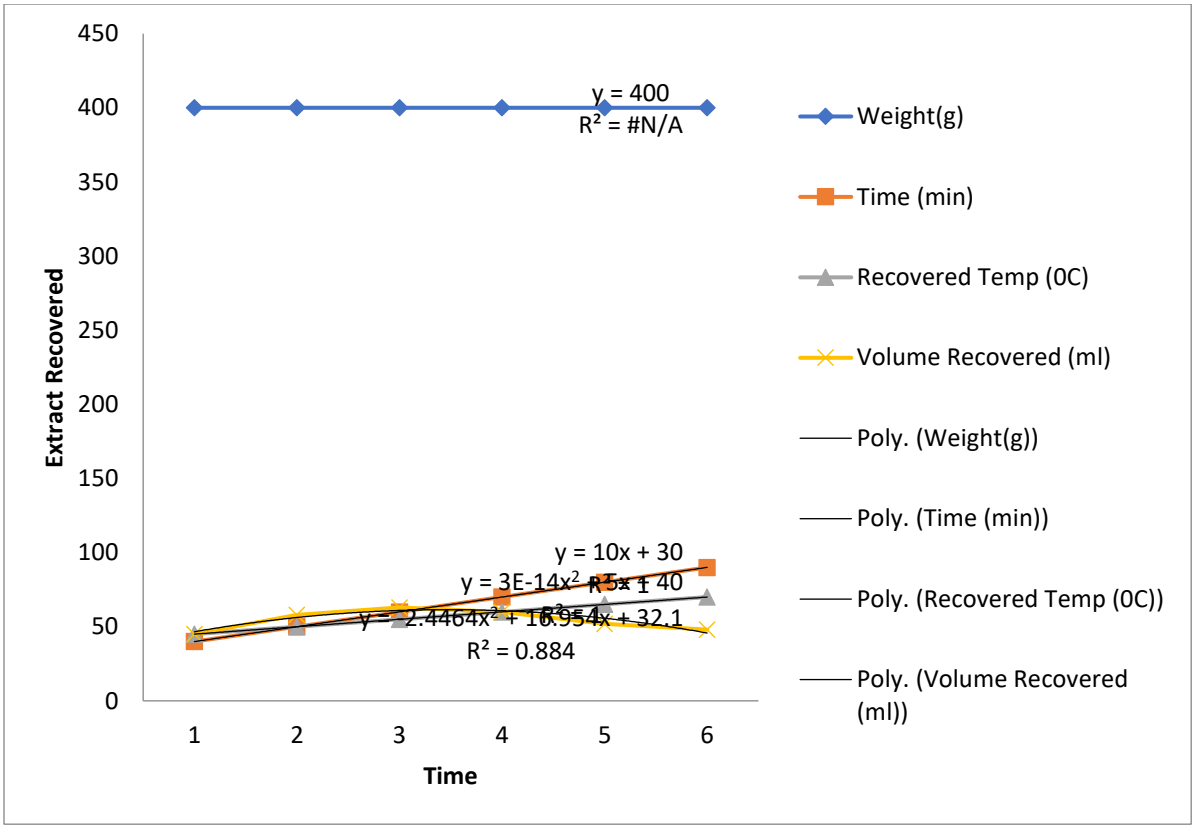

Figure 7: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 400g Upon the Influence of Time and Temperature Condition for Enugu Specie

Figure 7 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Enugu specie at a constant weight of 400g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered

can be attributed to variation in significant effect of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as $y = 10x^2 + 30x$ and square root of the best fit is given as $R^2 = 0.884$. All the functional parameters have its square root as R^2=1.

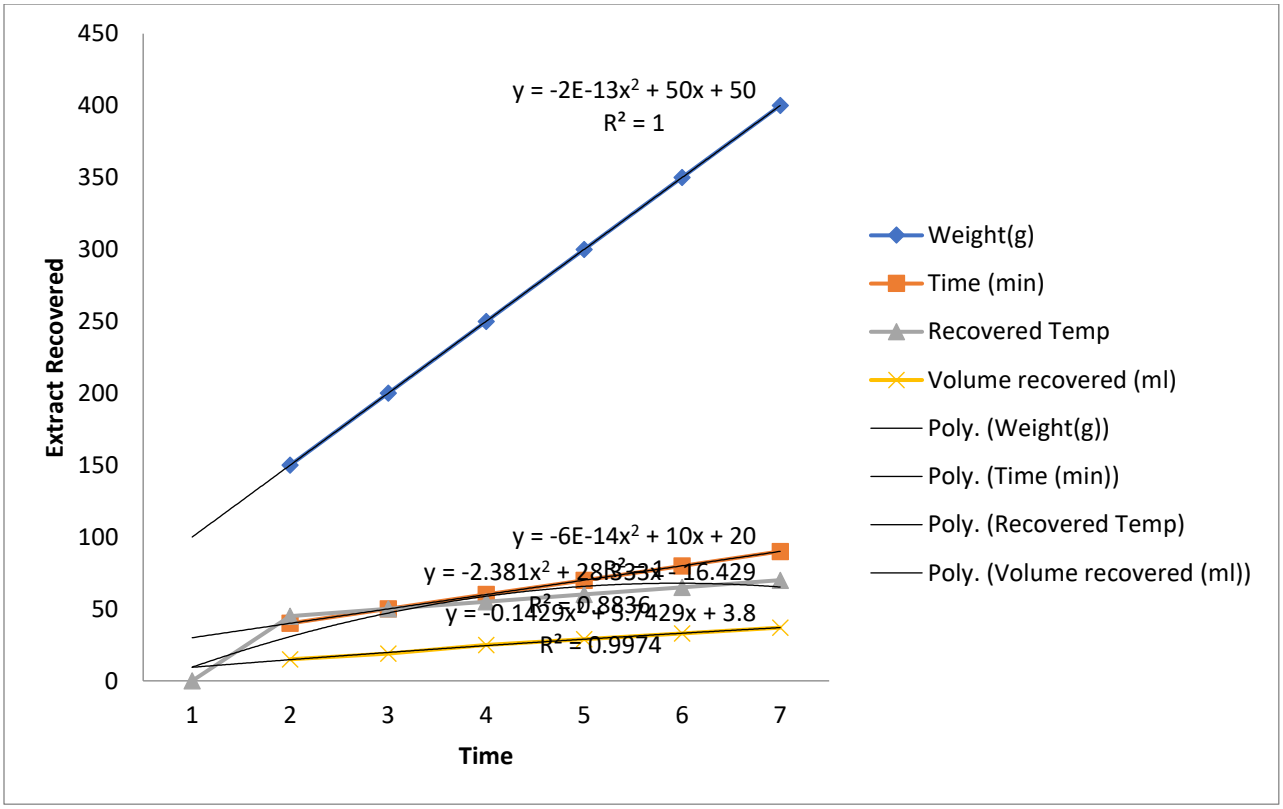

Figure 8: Graph of Oil from Mango Seed Extract Recovered in terms of Varied Weight, Time and Temperature Opioro specie

Figure 8 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Opioro specie. It was seen that the functional parameter of extract recovered varied with weight, time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 150g to 400g (dosage) when the concerntration(dosage) is varied. All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it rising and a gradual decrease as the time of extraction increases. The variation in the volume of extract recovered can be attributed to variation in weight (concentration) charged and significant effect of time and temperature. The equation of the line curve for oil recovered in mango

seed oil Bacon specie is given as $y = 0.8214x^2 - 2.0929x + 19.2$ and square root of the best fit is given as $R^2 = 0.9974$. All the functional parameters have its square root as R^2 =1.

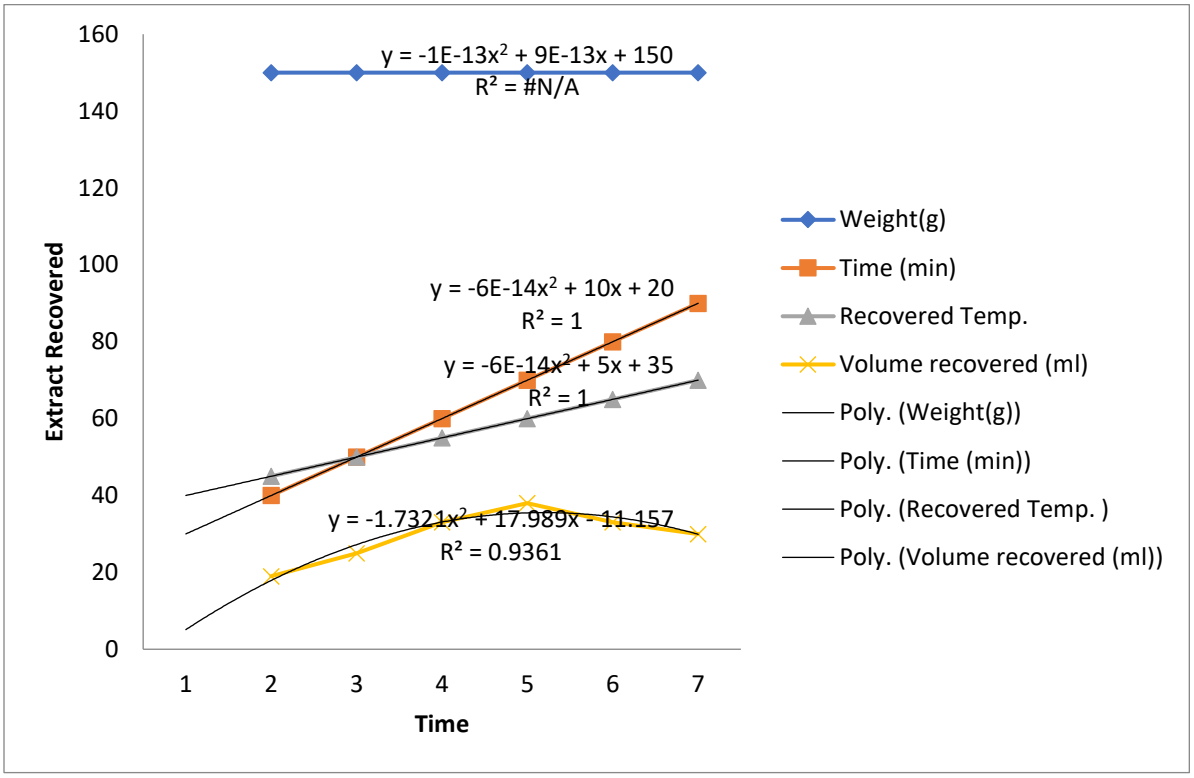

Figure 9: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 150g Upon the Influence of Time and Temperature Condition for Opioro Specie

Figure 9 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Opioro specie at a constant weight of 150g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve

for oil recovered in mango seed oil Bacon specie is given as$y = -6E - 14x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.9361$. All the functional parameters have its square root as R^2=1.

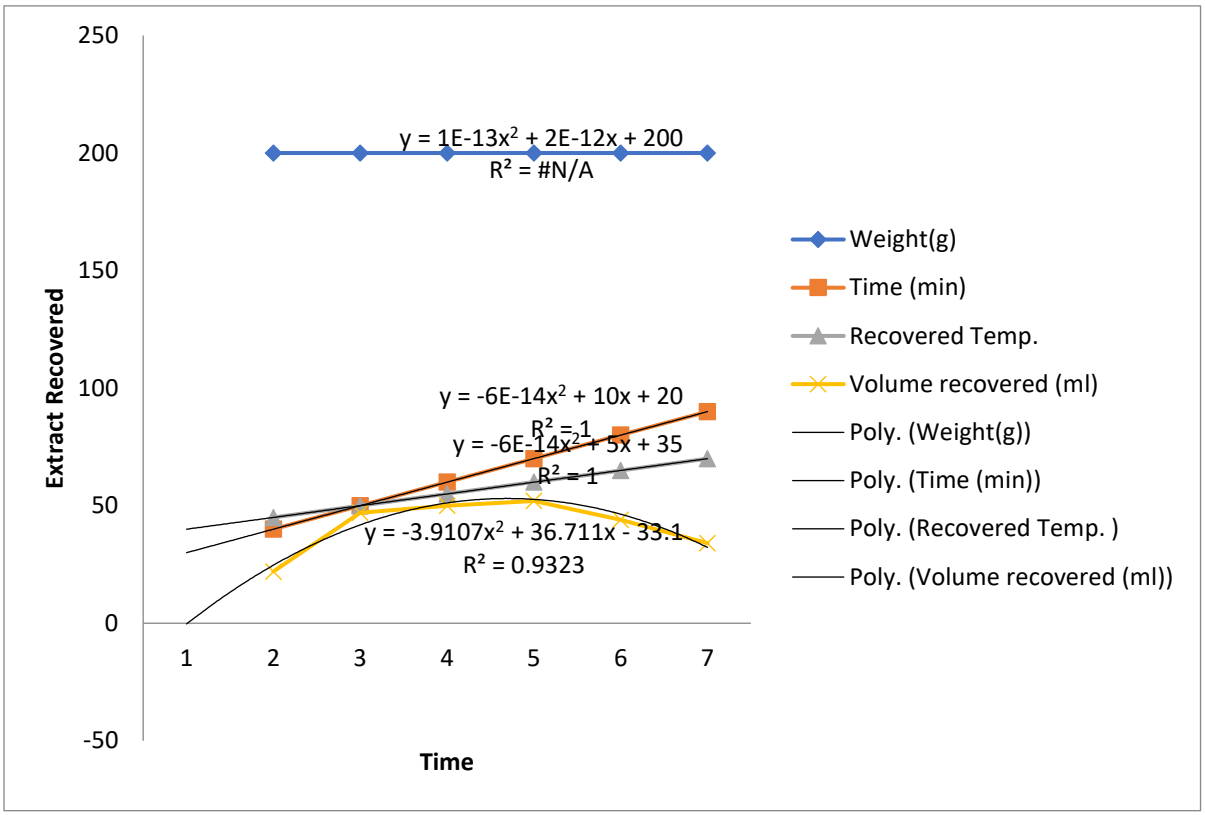

Figure 10: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 200g Upon the Influence of Time and Temperature Condition for Opioro Specie

Figure 10 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Opioro specie at a constant weight of 200g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve

for oil recovered in mango seed oil Bacon specie is given as$y = -6E - 14x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.9323$. All the functional parameters have its square root as R^2=1.

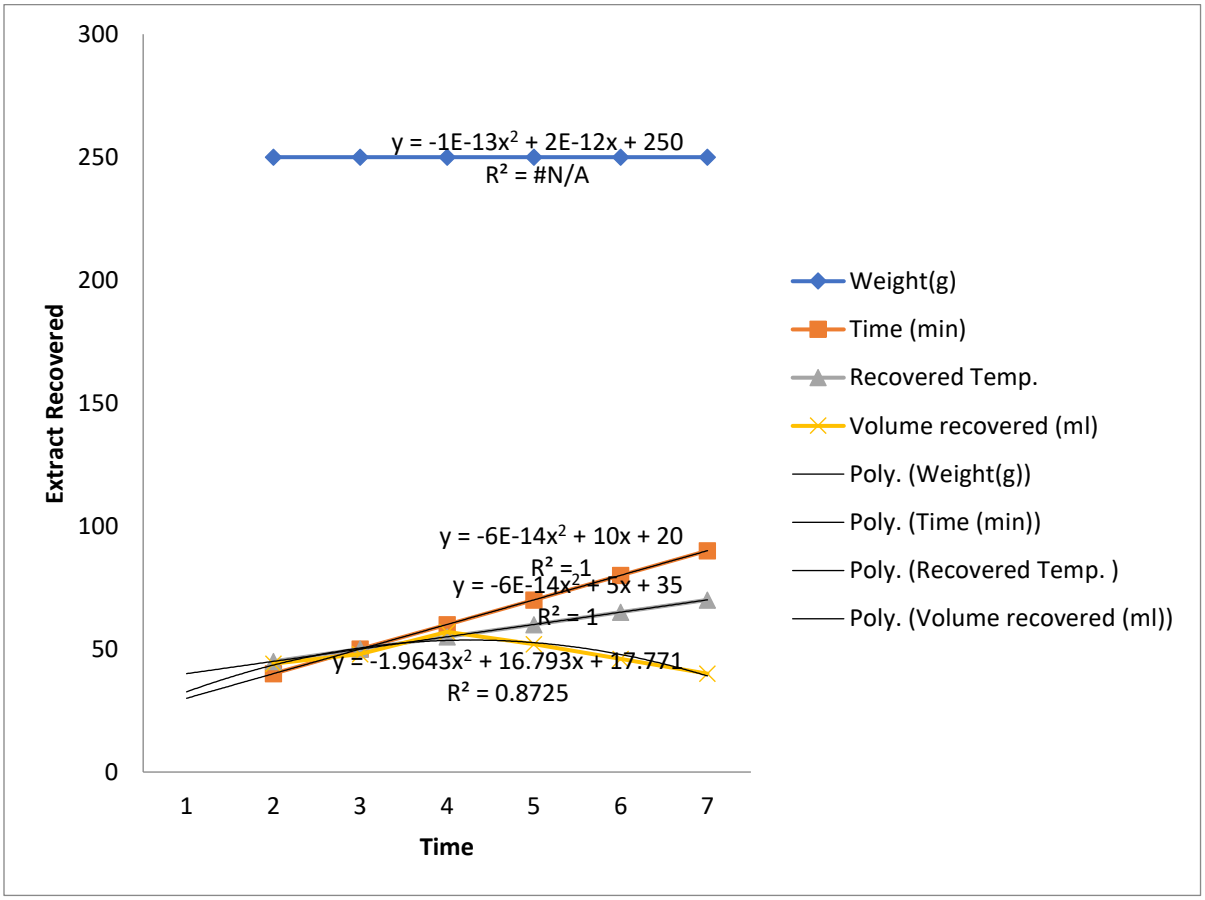

Figure 11: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 250g Upon the Influence of Time and Temperature Condition for Opioro Specie

Figure 11 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Opioro specie at a constant weight of 250g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered

can be attributed to variation in significant effect of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = -6E - 14x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.8725$. All the functional parameters have its square root as R^2=1.

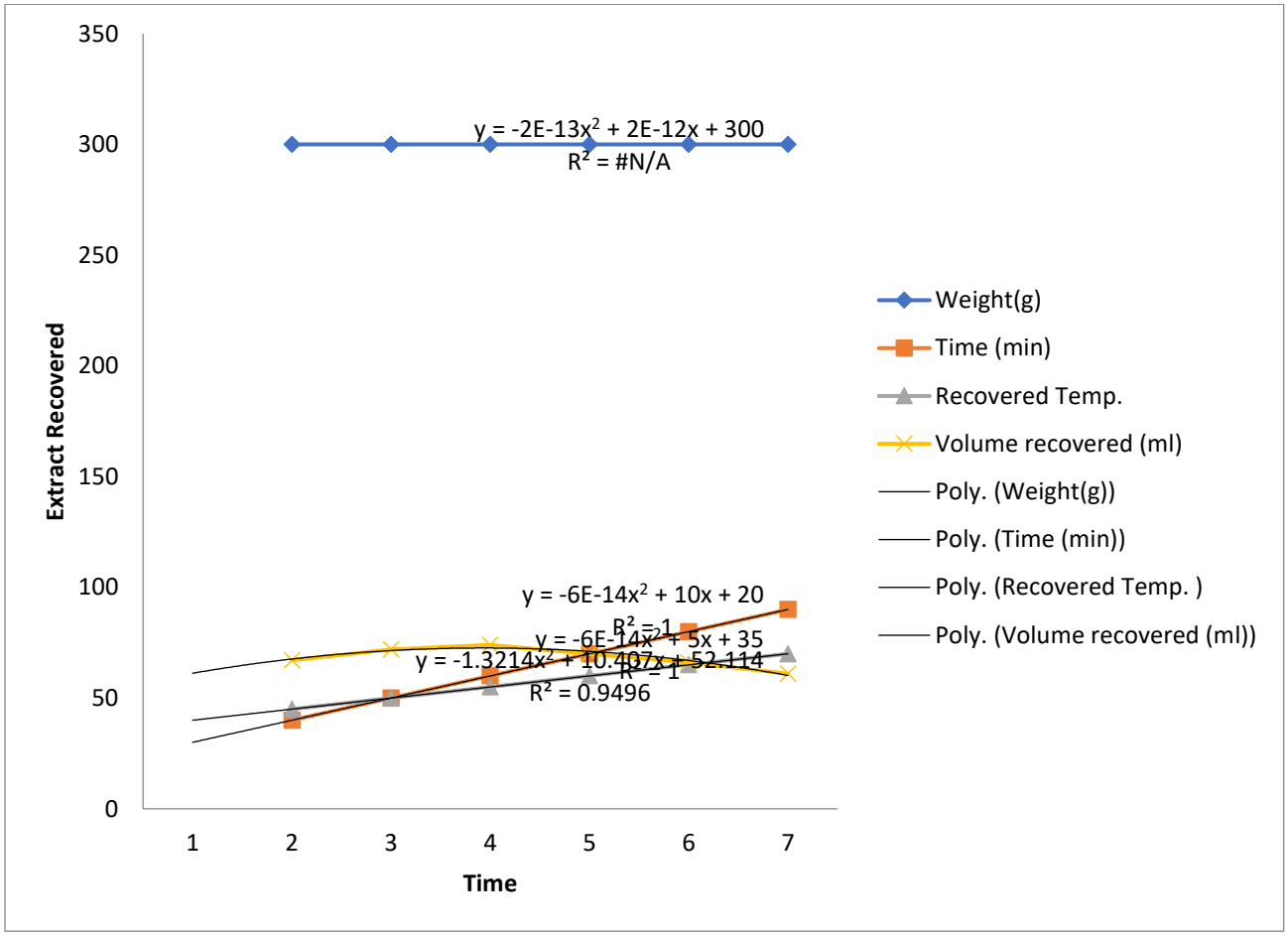

Figure 12: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 300g Upon the Influence of Time and Temperature Condition for Opioro Specie

Figure 12 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Opioro specie at a constant weight of 300g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The

volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as $y = -6E - 14x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.9496$. All the functional parameters have its square root as R^2=1.

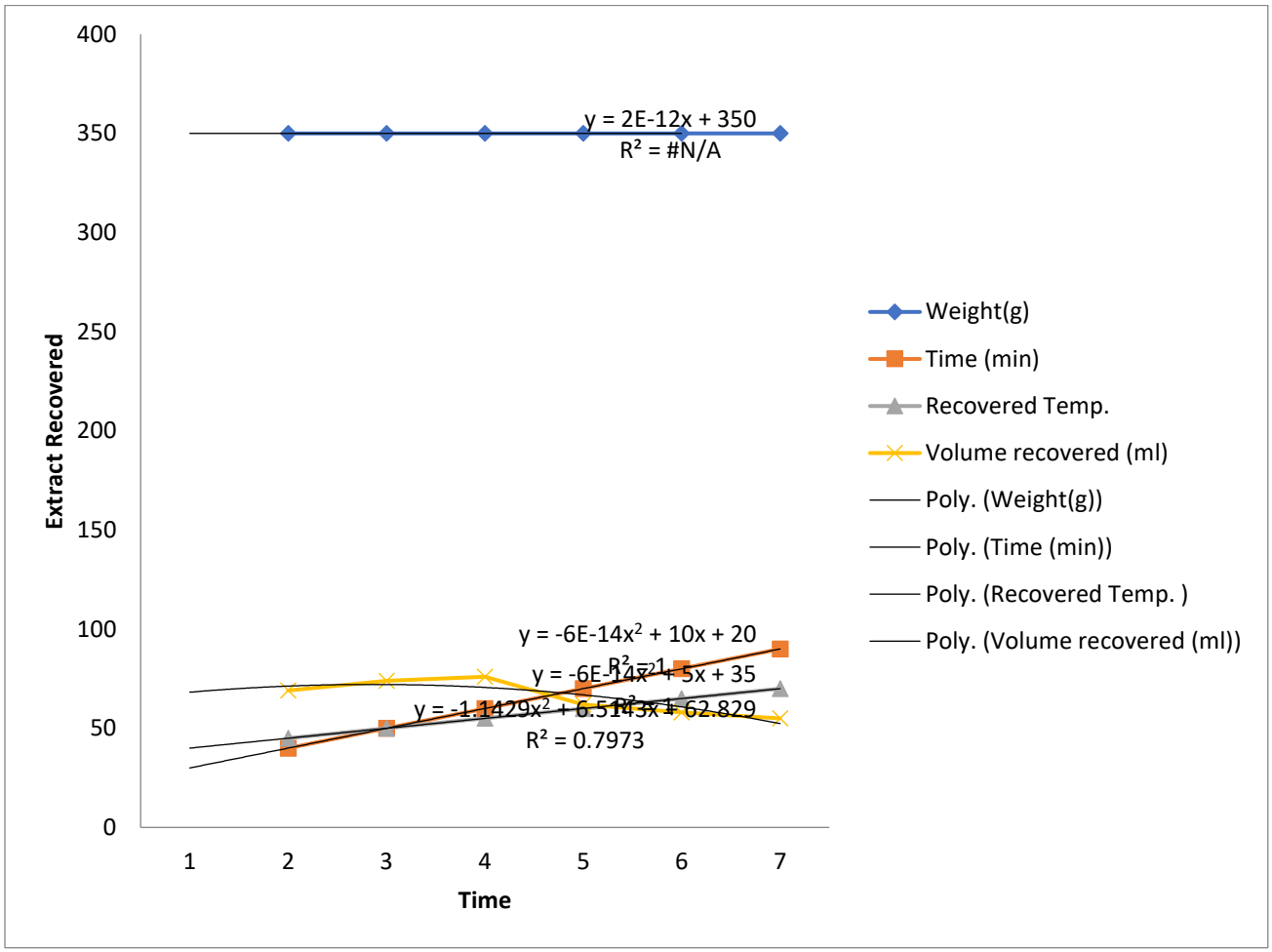

Figure 13: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 350g Upon the Influence of Time and Temperature Condition for Opioro Specie

Figure 13 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Opioro specie at a constant weight of 350g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased

from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = -6E - 14x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.9323$. All the functional parameters have its square root as R^2=1.

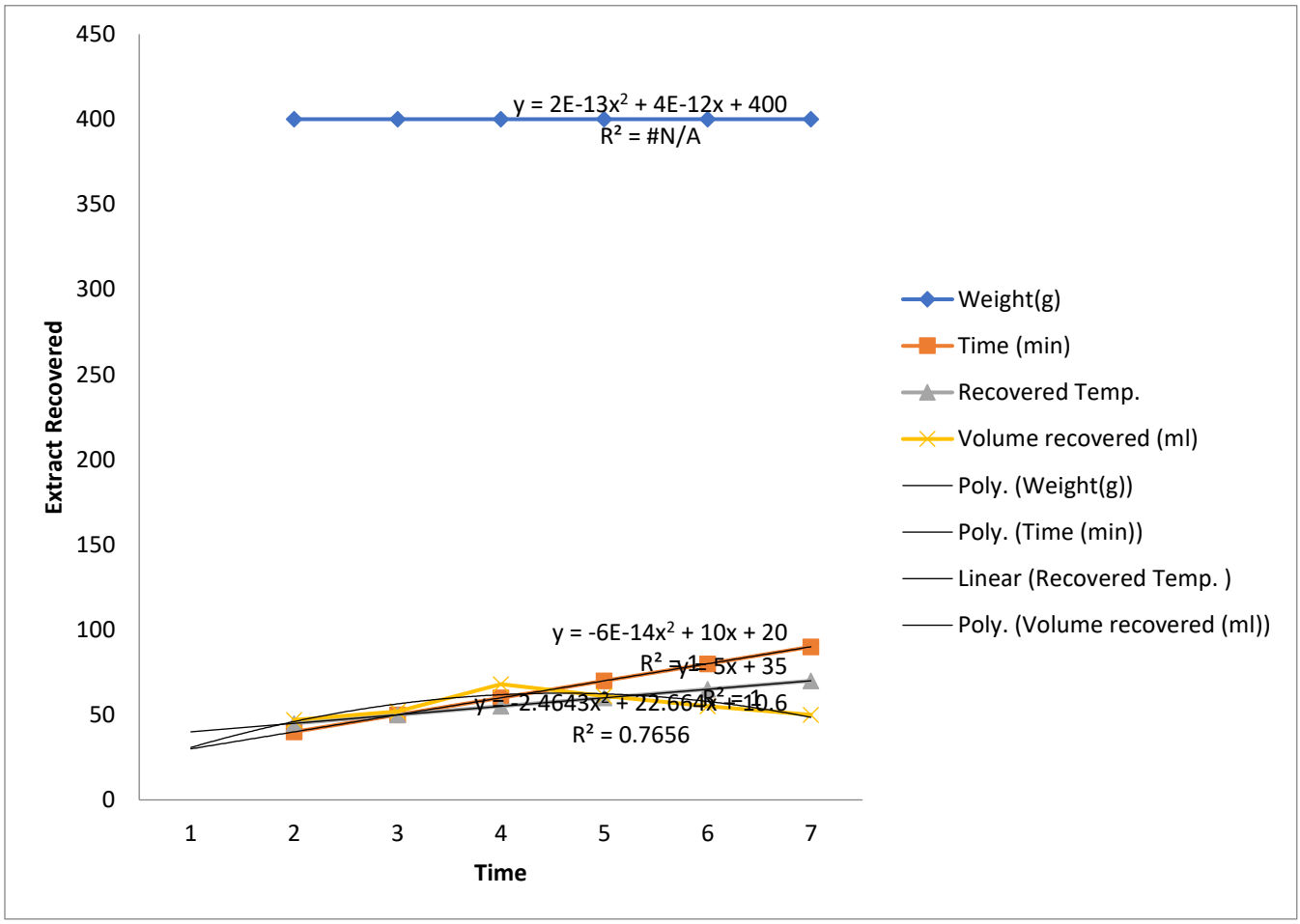

Figure 14: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 400g Upon the Influence of Time and Temperature Condition for Opioro Specie

Figure 14 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Opioro specie at a constant weight of 400g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the

Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as When extraction duration grows. The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered could be explained by changes in the substantial impact of time and temperature.

The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = -6E - 14x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.7656$. All the functional parameters have its square root as R^2 =1.

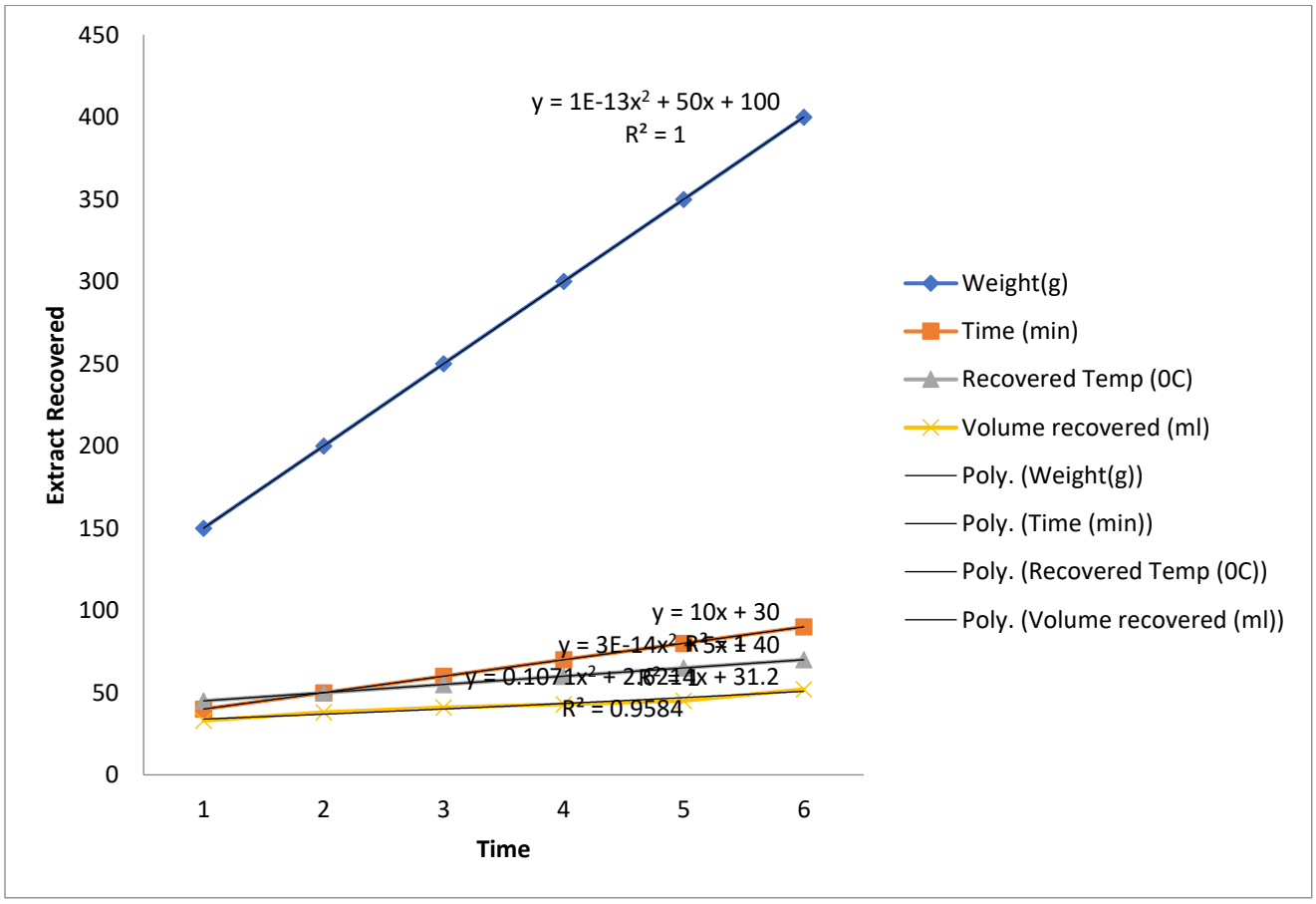

Figure 15: Graph of Oil from Mango Seed Extract Recovered in terms of Varied Weight, Time and Temperature Benue specie

Figure 15 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Benue specie. It was seen that the functional

parameter of extract recovered varied with weight, time and temperature for the Benue specie. Increase in the extract recovered was observed within the range of 150g to 400g (dosage) when the concerntration(dosage) is varied. All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it rising and a gradual decrease as the time of extraction increases. There is a strong relationship between the effects of time and temperature, as well as the change in the charged weight (concentration), which causes the recovered volume of extract to vary. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as $y = 1E - 3 + 50x + 100$ and square root of the best fit is given as $R^2 = 0.9584$. All the functional parameters have its square root as R^2=1.

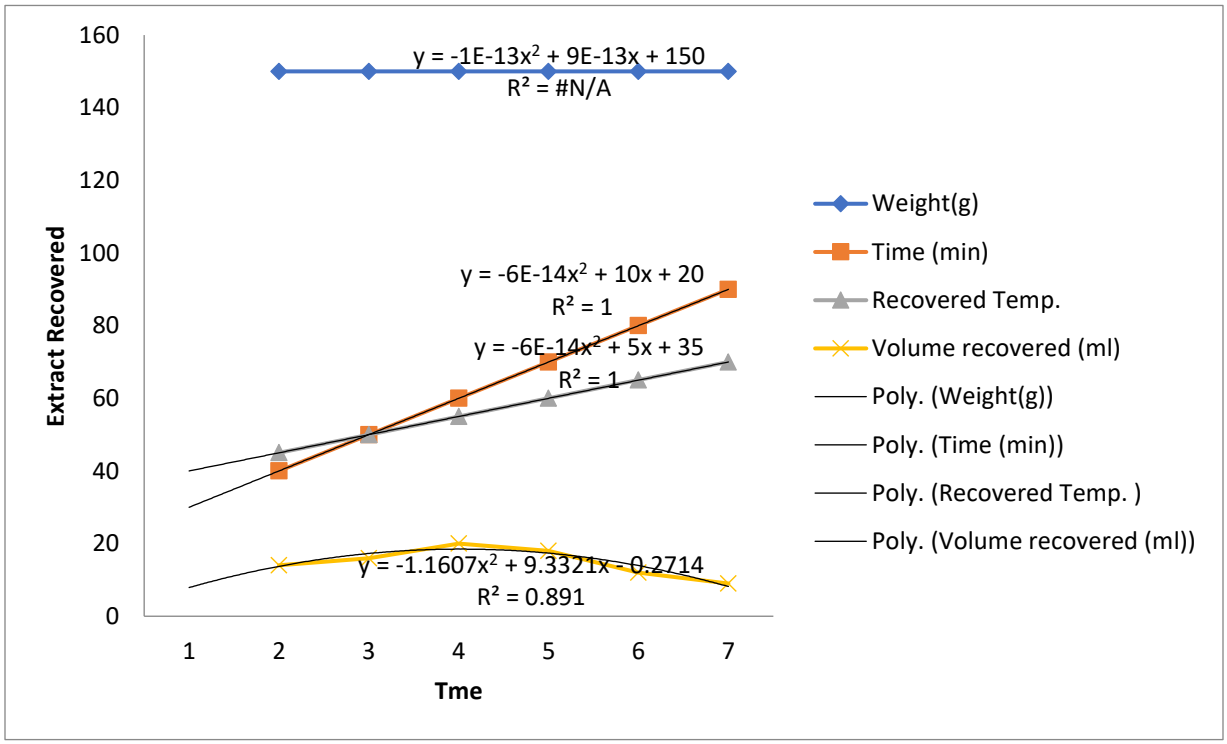

Figure 16: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 150g Upon the Influence of Time and Temperature Condition for Benue Specie

Figure 16 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Benue specie at a constant weight of 150g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as extraction becomes more time-consuming. The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered differs due to the substantial influence of time and temperature.

The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = 1.1607 + 9.3321 - 9.2714x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.891$. All the functional parameters have its square root as R^2 =1.

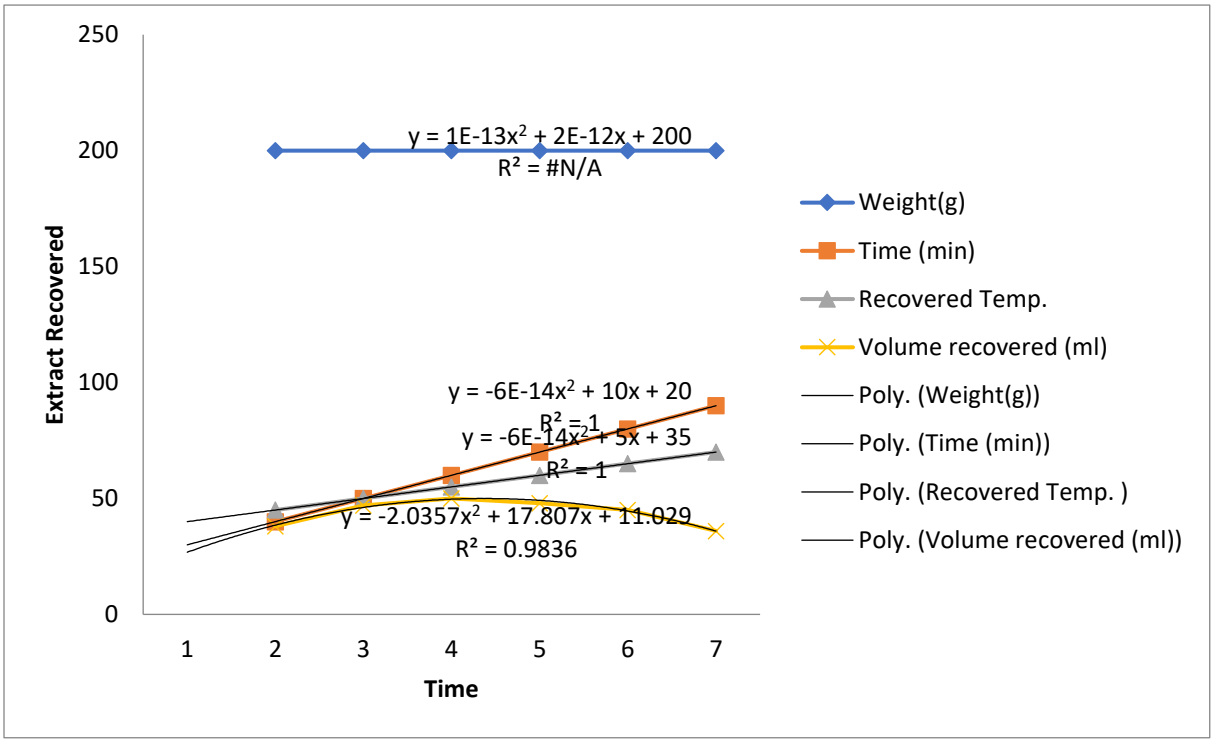

Figure 17: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 200g Upon the Influence of Time and Temperature Condition for Benue Specie

Figure 17 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Benue specie at a constant weight of 200g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as When extraction duration grows. The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered is likely due to changes in the substantial influence of temperature and time.The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = 1.1607 + 9.3321 - 9.2714x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.9836$. All the functional parameters have its square root as R^2=1.

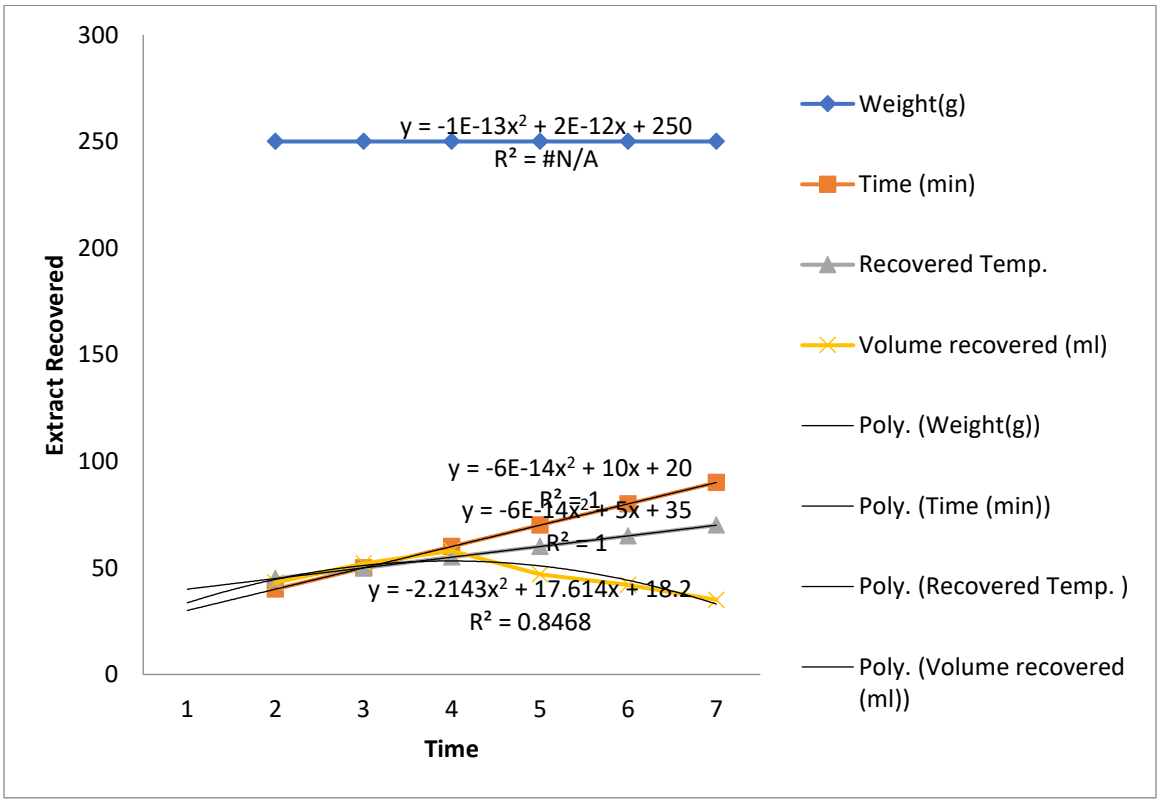

Figure 18: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 250g Upon the Influence of Time and Temperature Condition for Benue Specie

Figure 18 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Benue specie at a constant weight of 250g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered differs due to the substantial influence of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = 1.1607 + 9.3321 - 9.2714x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.8468$. All the functional parameters have its square root as R^2 =1.

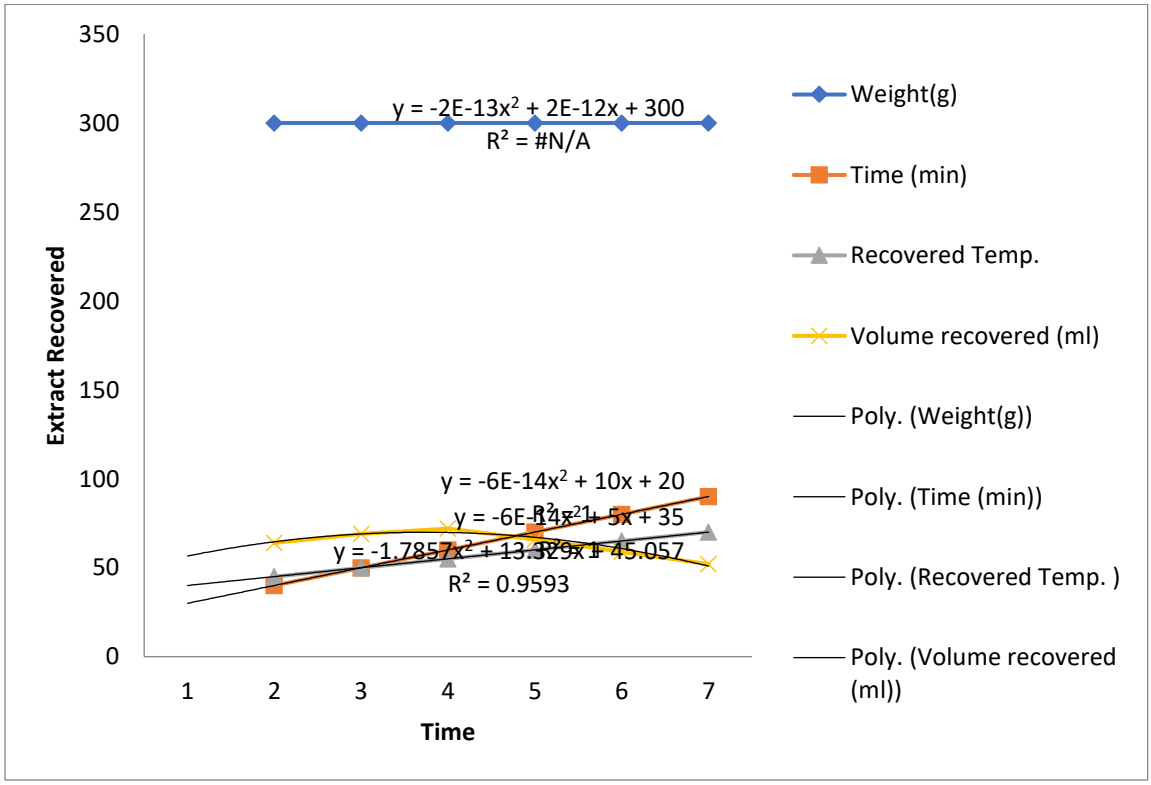

Figure 19: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 300g Upon the Influence of Time and Temperature Condition for Benue Specie

Figure 19 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Benue specie at a constant weight of 300g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as extraction takes longer. The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered has a substantial impact on time and temperature, which may vary. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = 1.1607 + 9.3321 - 9.2714x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.9593$. All the functional parameters have its square root as R^2 =1.

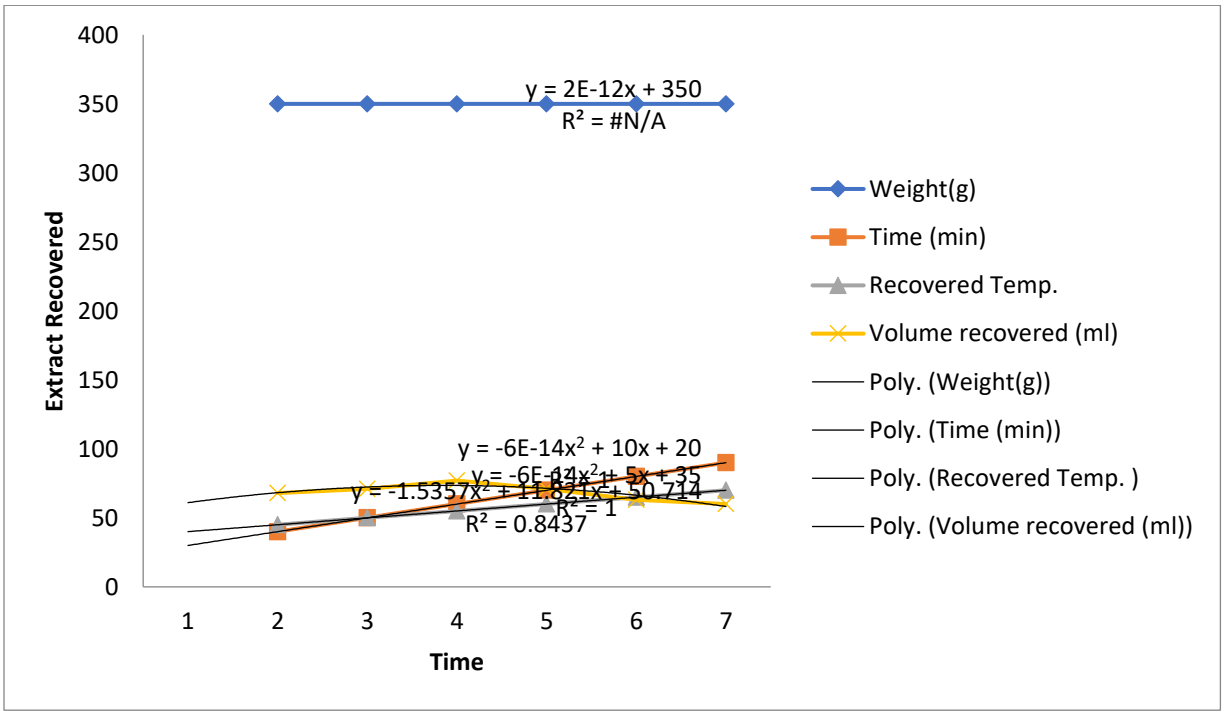

Figure 20: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 350g Upon the Influence of Time and Temperature Condition for Benue Specie

Figure 20 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Benue specie at a constant weight of 350g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = 1.1607 + 9.3321 - 9.2714x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.8437$. All the functional parameters have its square root as R^2 =1.

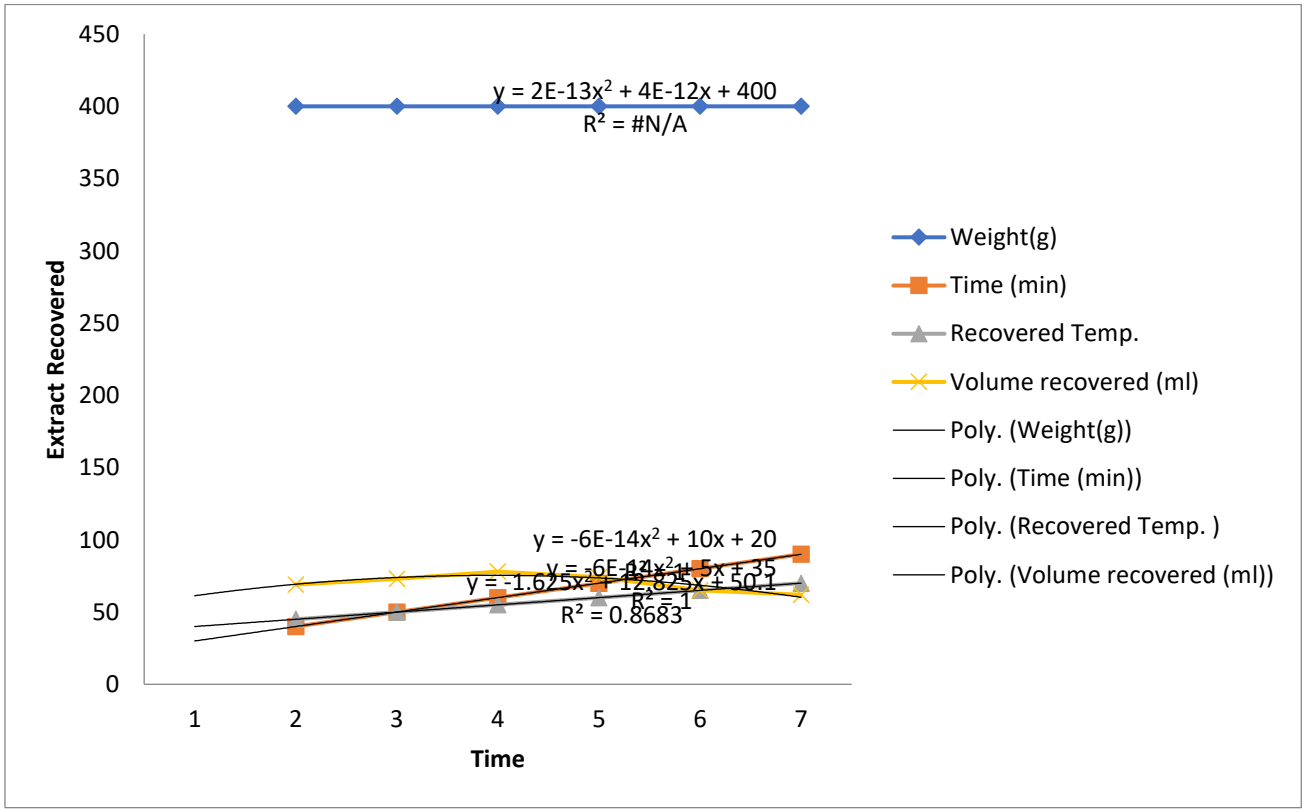

Figure 21: Graph of Oil from Mango Seed Extract Recovered at Constant Weight of 400g Upon the Influence of Time and Temperature Condition for Benue Specie

Figure 21 shows the relationship of the functional parameter concentration (g) of weight distillation time, temperation, and volume recovered for Mango seed oil of Benue specie at a constant weight of 400g. It was seen that the functional parameter of extract recovered varied increase in time and temperature for the Bacon specie. Increase in the extract recovered was observed within the range of 40 minutes and decreased from 50 minutes to 70 minutes. . All other funtional parameters (time and temperature) also had an increase in volume of extract recovered as it was rising and a gradual decrease as the time of extraction increases.The volume of extrac reduced at 55 minutes to 70 minutes. The variation in the volume of extract recovered can be attributed to variation in significant effect of time and temperature. The equation of the line curve for oil recovered in mango seed oil Bacon specie is given as$y = 1.1607 + 9.3321 - 9.2714x^2 + 10x + 20$ and square root of the best fit is given as $R^2 = 0.8437$. All the functional parameters have its square root as R^2 =1.

CONCLUSION

Different types of extraction processes had been in vogue such as steam, solvent enzyme assisted aqueous extraction, ultra sound-Assisted extraction using solvents, extraction using high hydrostatic pressure, extraction using extrusion and subsequent expulsion, microwave assisted extraction, supercritical fluid extraction etc which have been yielding oil with traceable contaminants. This my research method "mechano-thermal extraction/distillation" have

i. Introduced a modern and unique method of extraction/ distillation processes that its product is pure and devoid of any trace of contaminant.
ii. The 3 agro seeds of mango seeds with different concentrations of both physical and chemical properties.
iii. The physiochemical and HPLC/ MS GC analysis dictated properties that can serve as raw materials in chemical, pharmaceutical and food industries.

iv. The extraction and usage the oil obtained from the agro seeds will help the 3 industries (chemical, pharmaceutical and food industries) of producing vital raw materials locally instead of depending on conventional one thereby promoting local content.

v. The oil recovered from this process does not need any other treatment such as preservatives, demoisturising deordering, decolourising, dewaxing etc. as it is natural pure and last for a longer period without ranciding

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