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Impacts of Natural Plant Extract on Quality Of Gloss Paint

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Abstract:*The hazardous effect of lead human and other living organisms within the environment cannot be overemphasized. This was the reason why its replacement as drier in paint has attracted much research work in the recent time. In this study Castor see oil and almond seed oil were investigated for use as drier in gloss paint. Gloss paint were produced using standard method with various samples containing the seed oil in different composition of 0.1%, 0.2%, 0.3% and 0.4%. Also, samples of the paint containing lead were produced for comparative analysis. All the paint samples were anlysed with standard methods to determine their dry times, spread rat, viscosity, solid content opacity, among others. The result obtained showed that the castor oil and almond oil could present a better alternative to the use of lead carbonate in terms of low viscosity, moderate spread rate, among and moderate drying time. In conclusion, it is shown from the result that the properties of natural paint blend additives (Almond and castor seed oil) shows some better properties compared to lead-based paint. Hence, natural based paint drier can replace lead carbonate-based paint which is dangerous to nervous system when inhaled. The use of castor and almond seed oil as additives, in gloss paints are now strongly recommended, in order to check-mate release of greenhouse gases in lead carbonate blend additive paint, during paint drying which are hazardous to life.*

Keywords:gloss paint, castor seed oil, almond seed oil, drying time

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I. INTRODUCTION

Most chemical available paints drier additives contain lead carbonate.Lead carbonate takes a long period of time to begin to manifest and the effect of using a lead base paint is so enormous.One would inhale it gradually without even knowing its taking something dangerous and the kidney, the nervous system and causing stunted growth.However, this study tends to produce a lead-free paint in to replace lead based paint. Lead is used in paints because it helps in drying quickly and makes the paint durable. This made lead paints popular for use in homes, on metal exposed to the elements, and even children's toys. Both children and adults are at risk when exposed to lead paint. Paint applied to roads, highways, steel structures, industrial buildings, vehicles, and farm equipment all need to be lead-free. When these paints grow old, it degrades, flakes off and chips fall. This is the culprit behind long-term slow air pollution and soil contamination. This is a bigger problem when the paint is removed. The workers at these places are exposed to lead and take home this poison in their clothes, hair, and skin. The problem is industrial paints are applied to homes, schools etc.

Thus, the need to find alternative to lead utilization in paint production in Nigeria cannot be overemphasized. Castor seed oil (*Ricinus comminus*), as one of the drying vegetable oils derived from the castor oil plant seed, of the family Euphorbiaceous. Similarly, almond oil derived from almond fruit seed could be useful alternative to the lead drier in the paint industry. It is one of the most widely used film-forming oil with applications in decorative, communication and surface coating. The seed plant is widely spread throughout tropical region of Africa, India and the Mediterranean areas, where they are cultivated as ornamental flowering plants. The sprig fruit which is greenish to reddish-purple capsules when matured contain s the large oval shinny bean-like poisonous seed (Sabina *et al* 2009). The seed oil is colourless to pale yellow with mild odour, tastes, and commonly referred to as "Palma Christi" or "Palm of Christ" due to their medicinal treatment for constipation, wounds, skin diseases etc (Kalaiselvi *et al* 2003).it is one of the drying oil that could cross-link on exposure to air to form a solid dry film, a property that makes it unique component in automotive paint making. Thus, this study investigated the possibilities of replacing lead component of paint with castor seed oil and almond seed oil as drying agents.

II. EXPERIMENTAL PROCEDURE

2.1 Materials

The castor and almond seed oil were obtained from Ayetoro market, in Epe local government Area of Lagos State. All chemicals products for the paint production were bought from accredited chemical dealer in Lagos, Nigeria the chemical product were industrial grade with high purity. The chemical products used were lead, titanium oxide, resin, kerosene. Major pieces of equipment used in the study are weighing balance (BH – 600 model), BK drying time recorder, Ford #4 viscometer.

Table 1 component and measurement of paint for production

Components	**Weight (grams)**
Binder (resin)	30
Solvent (kerosene)	50
Pigments (titan)	50
Additives (lead carbonate, Castor seed oil, Almond seed oil)	5, 7, 10.
Texanol	5
Antiskin	5

2.2 Methods

2.2.1 Production of Paint

The paint mixer was properly cleaned. 50g Kerosene and 300g Alkyd resin were poured into the high-speed dissolver machine and mixed thoroughly for 10minutes (Table 1).Afterwards, 50g of titanium dioxide, 5g of antiskin and 5g of texanol were added to the mixture. **(**The antiskin and texanol enhances the breakdown of the pigment) and then it was dispersed for about 40minutes. Alkyd resin and kerosene were added and allowed to run for some minutes. (This was used to adjust the dispersed mixture to avoid overflow). The driers were then added in the desired ratio. The paint mixture was divided into 12 different groups and the driers were added in different blends and concentration. The ratios in which the driers were blend are shown in Table 2. Then the specific gravity and the viscosity of mixture were checked.The blue, white and yellow oxides were added separately to tint the colour to the desired one.

Table 2 Compositions of driers in the paint blends

Dryer	**Colour**	**Grams**
Lead blend	White	5 g
	Blue	5 g
	Yellow	5 g
Castor seed Oil	White	2.5g, 5g, 7.5g, 10g
	Blue	2.5g, 5g, 7.5g, 10g
	Yellow	2.5g, 5g, 7.5g, 10g
Almond seed Oil	White	2.5g, 5g, 7.5g, 10g
	Blue	2.5g, 5g, 7.5g, 10g
	Yellow	2.5g, 5g, 7.5g, 10g

2.2.2 Test for Drying time

The drying time of the oil was monitored under the atmospheric condition and the period of film formation was recorded at 30minutes, which was quite good for surface coatings, according to Daniel paint standard (2007). The drying time of each paint sample was determined using BK drying time recorder.

2.2.3 Specific gravity

The weighing balance was calibrated. Thereafter, an empty crucible was weighed to obtain 'W_o'. The crucible was filled with water and weighed to obtain "W_1". Then 3g of each paint sample was added in each of the empty crucible and weighed again "W_2". Each sample was placed in laboratory oven for 1 hour at 80^{o}C. After 1 hour, the samples were removed and place in the desicator to cool. Finally, the cooled sample was weighed again "W_3". The specific gravity was determined by equation (1).

Specific gravity = $\frac{W1-W0}{W2-W0}$ (1)

Where:

W_o = Weight of empty density bottle (g).
W_1 = weight of density bottle filled with water (g).
W_2 = weight of density bottle filled with oil (g).

2.2.4 Solid content

The weighing balance was calibrated, thereafter, an empty crucible was weighed "W_1". Then 3g of each paint sample was added in each of the empty crucible and weighed again "W_2". Each samples were place in laboratory oven for 1 hour at 80^{o}C. After 1 hour, the samples were removed and place in the desicator to cool. Finally, the cooled sample was weighed again "W_3". The solid content of the paint sample was determined using equation (2).

Solid content = $\frac{W2-W1}{W3} X\ 100$ (3)

Where:

W_1= weight of crucible alone in gram
W_2 = weight of crucible and paint sample before placement in the oven in gram
W_3 = weight of paint sample cooled in gram.

2.2.5 Spread rate determination

To determine the spread rate a measured small quantity was used on a cardboard. The spreading rate of the sample was calculated using equation (2).

Spreading rate = $\frac{AXSg}{\Delta W \times 10}$ (2)

where;

A = surface area of the metal sheet sample (m^2)
Sg = specific gravity of the sample
ΔW = change in sample weight before and after application

Solid content = $\frac{W2-W1}{W3} X\ 100$ (3)

Where:

W_1= weight of crucible alone in gram
W_2= weight of crucible and paint sample in gram
W3= weight of paint sample used in gram.

2.2.6 Viscosity

Viscosity is described as the thickness of paint; the higher the viscosity, the thicker the paint. It is a property in both alkyd and latex paints that resist flow and movement by force. The solvent used in the paint adjusts the paint viscosity such as minerals spirits in alkyds. Viscosity in paints is measured with a device called the viscometer and is read in units called poise (P). The viscosity testing was carried out on the paint samples using Ford #4 viscometer cup at 25^{o}C and a stop watch to monitor the flow resistance of the sample. The viscosities for all the produced paint samples were determined and recorded.

2.2.7 Opacity

Opacity testing was performed by spreading the paint on an opacity white paper with black lines across them, and the hiding ability of the research paint was observed visually. The paint sample was thinned down for

easy brushing before spraying on the metallic panels using a spray gun, while the storage temperature was also determined by the drying time monitoring (Oguniyi, 2006).

III. RESULTS AND DISCUSSIONS

3.1 Solid content

The values of the solid content of castor seed oil and almond seed oil (41%, 35%) are low compare to the lead carbonate blend paint additives. Almond and Castor seed oil blend additives increases the acrylic gel of the paint. Hence, the later showed that the gloss paint does not have much coverage due to lack of paste. A high solid paint is considered to be at least 65% solid components. This includes the binders, any additives and the pigments. Sample white with 10g castor oil blend was found to have a total solid content of 66%, which is considered to be within high solid content range.

3.2 Opacity

The opacity result of the castor and almond seed oil plasticized auto-paint as shown on Table 2, indicated that the hiding ability is quite better than the unplasticized sample paint compared to the lead carbonate blend additives paint. This could be attributed to the cross-linking effect of the castor and almond oil as plasticizer, when exposed to the atmospheric oxygen, Wollensak, et al, (2003). The viscosity values for castor and almond oil blend paint sample is lower, because addition of the oils reduces the cohesion of the intermolecular forces along the chains and increases free flow, flexibility, elongation and workability of the paint components (Figures 9 and 10). Ibemesi and Attah (1990) had suggested that drying time of plasticized paints are generally reduced, due to the presence of the ricinoleic acid in natural castor seed oil. The stages of dryness, from touch dry time to hard dry time, exhibited satisfactory quality for the research plasticized automotive paint as compared to the unplasticized lead carbonate blend paint (Table 3). The castor and almond seed oil plasticized gloss paint exhibited higher gloss, flexibility, increased adhesion, durability, smooth, ruby and provided additional protections to the substrate against corrosion and other weather conditions, as was observed on the coated steel panel, in accordance to the contributions of Daniel (2007).

Table 3: Summary of results of some quality control testes carried out on the paint samples

	Castor and almond oil blend paint sample		**Lead carbonate blend paint sample**
Test	Plasticized	unplasticized	Plasticized
Opacity	Excellent	Fair	Good
Viscosity (%)	0.2 - 0.5	0.96	0.97
Specific gravity (g/cm^2)	0.7 - 0.9	1.75	1.16
Drying time (minutes);			
Touch dry time	1 – 92	01	– 3
Hard dry time	65 - 110	100	85

3.3 Drying time

From the results obtained as shown in Figures 1 to 4, as the quantity of the drier additives increases, the drying rate also increases. The sample blend of lead carbonate generally has the best drying rate amongst all drier additives used (Figures 5 and 6). However, both castor oil and almond seed oil also has an acceptable drying time. The sample yellow, blend with 7.5g of castor oil has the shortest touch dry time to hard dry time (1.38 – 65 minutes) (Figures 1 and 2), while sample white, blend with 5g of almond seed oil has the longest touch dry time to hard dry time (8.87 – 100 minutes) (Figure 3 and 4). Hence, the sample blends of lead carbonate additives proved to have the shortest touch dry time (2.97, 2.35,1.97 minutes) for yellow, blue and white paint respectively (Figure 5). The lead carbonate blend sample has same hard dry time (85 minutes) (Figure 6).

Almond seed oil blends samples displayed longest touch dry to dry time relatively close to castor oil and lead carbonate blends drying time. However, the results in this study has proven that castor oil and almond oil are good drier and can be used to replace lead in lead-based paints and the more quantity of almond and castor oil added, the faster it is to dry.

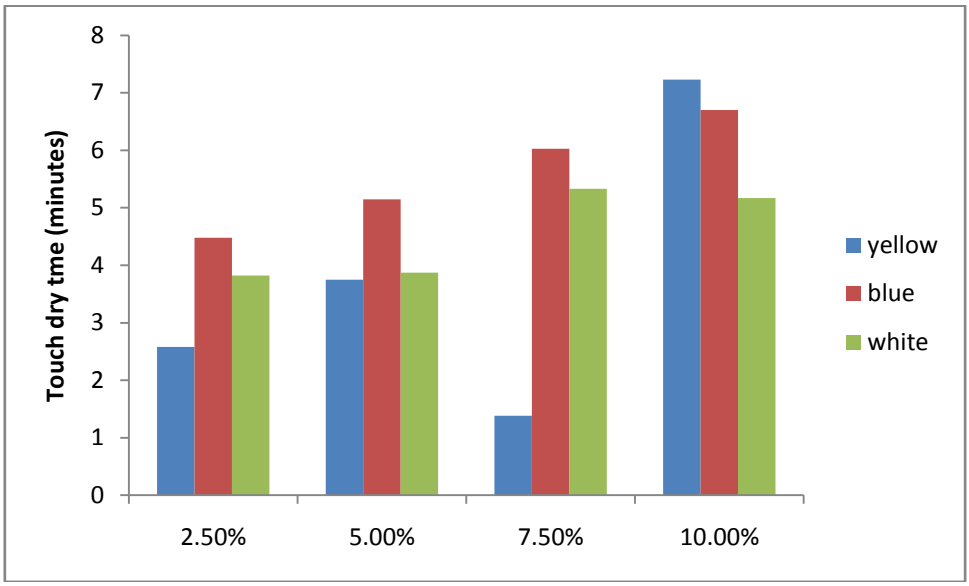

Figure 1. Touch dry time of castor oil drier paint sample

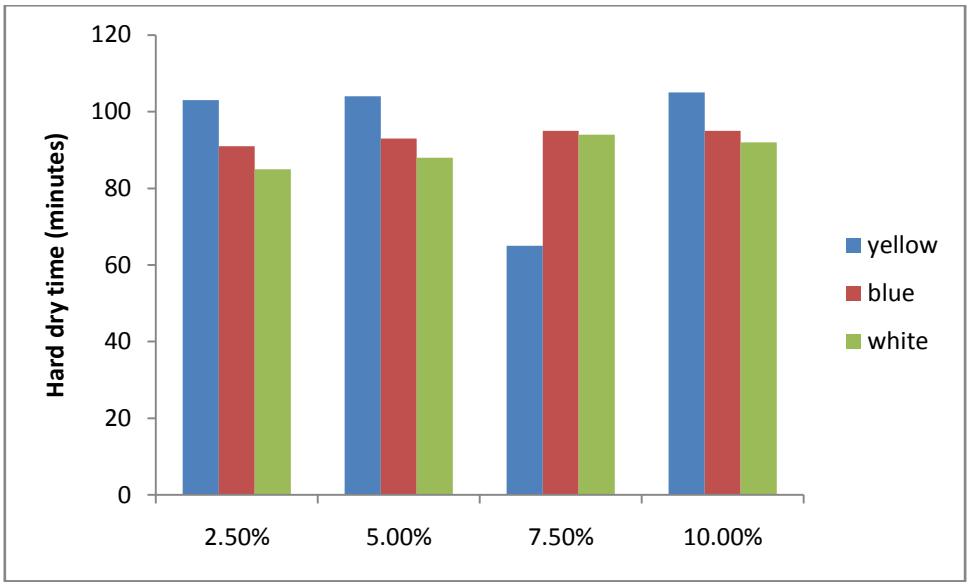

Figure 2. Hard dry time of castor oil drier paint sample

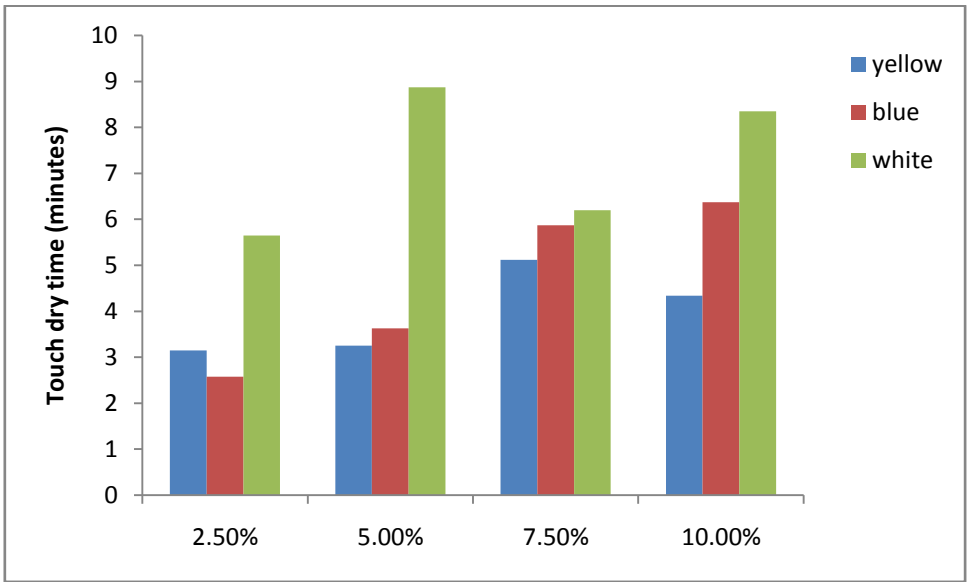

Figure 3. Touch dry time of almond oil drier paint sample

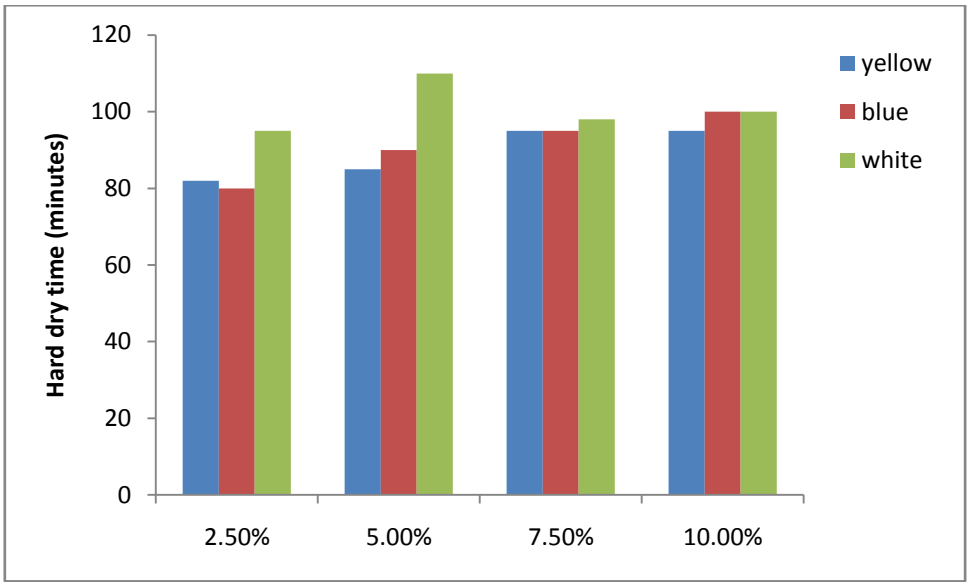

Figure 4. Hard dry time of almond oil drier paint sample

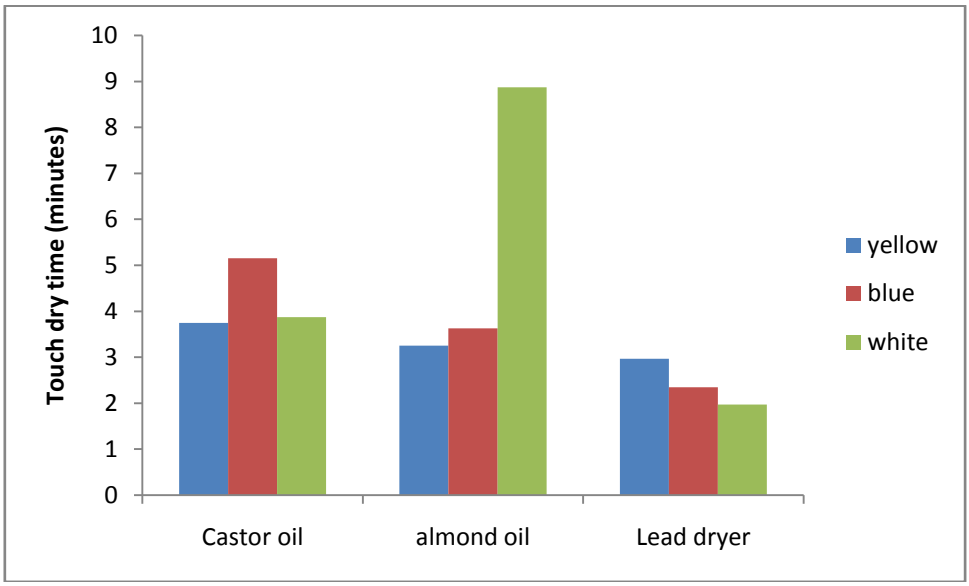

Figure 5. Touch dry time for paint samples at 5g drier additive

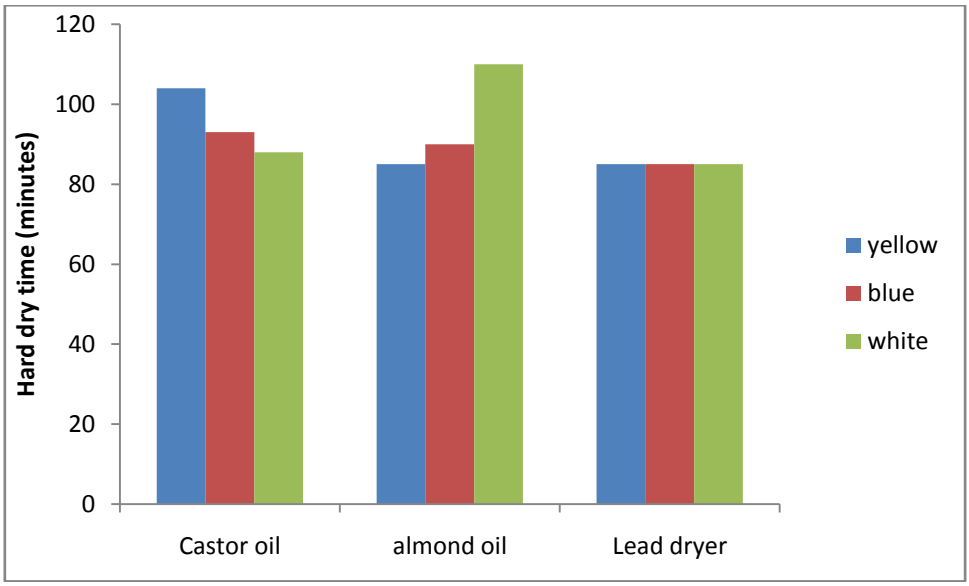

Figure 6. Hard dry time for paint samples at 5g drier additive

3.4 Viscosity

Gloss paints between 56 – 100 Poise is said to have a high viscosity (which are resistance to free flow), gloss paint within the range of (35 – 55 Poise) is said to be moderately free to flow. While gloss paint with viscosity in the range (35 Poise below) has a good viscous property while allowing a heavier film application. From the result (Figures 7 and 8), its shows that all the samples has a good viscous flow except from the lead carbonate blend samples which has a viscosity of (93 – 95 Poise) which might be effect of high temperature and pressure of lead carbonate.

The viscosity of the lead carbonate blend additives 0.93mPa.s are high as compared to the castor and almond seed oil blend additives (0.33, 0.37) respectively, which are the industrial standard for auto-paint making according Daniel, (2007). The high viscosity of lead carbonate blend over castor and almond seed oil blend additives is an advantage to control the melt flow of auto-paints. The higher specific gravity of (0.9 – 0.96 g/cm^3), castor and almond blend of the oil sample is attributed to the solvent contamination during the extraction process.

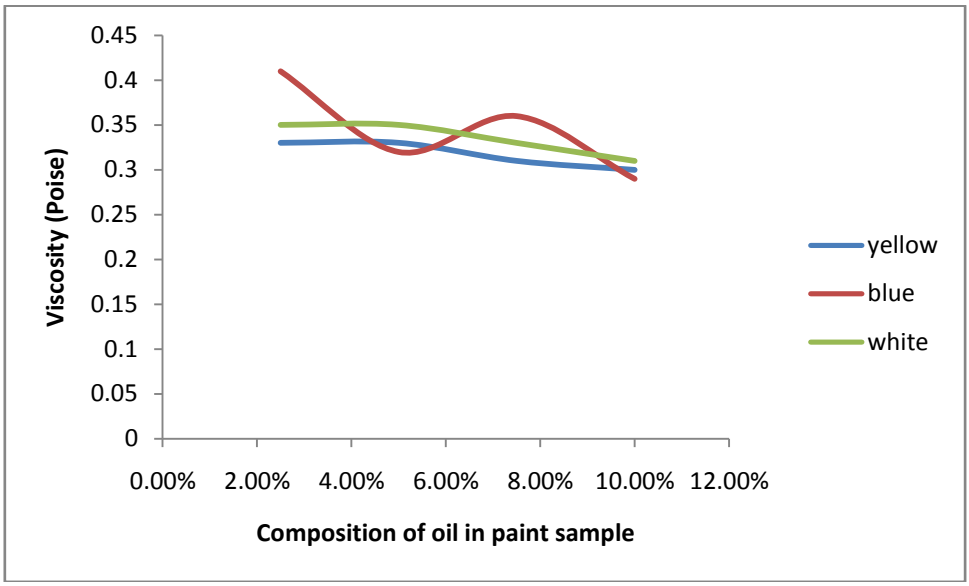

Figure 7 Viscosity of paint sample containing castor oil at different concentrations

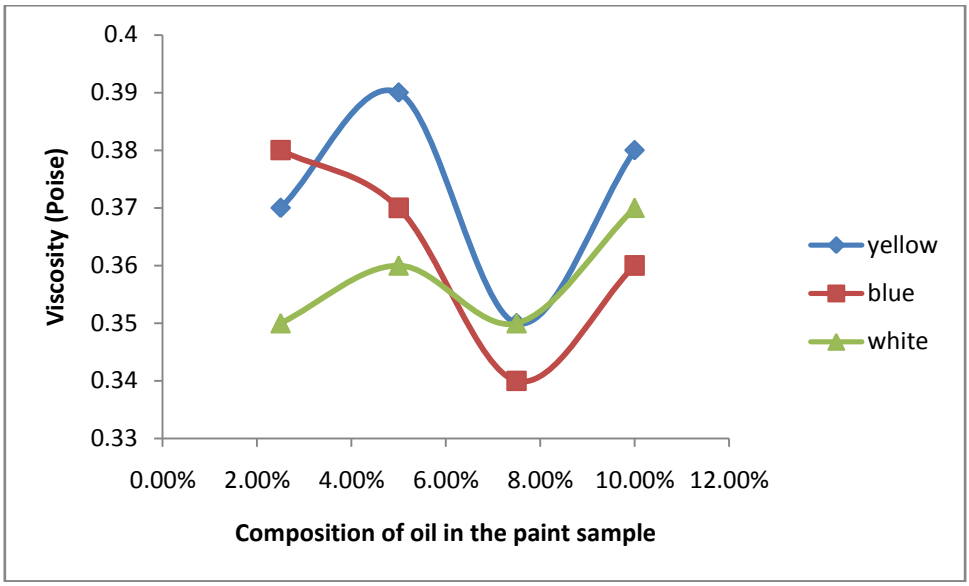

Figure 8 Viscosity of paint sample containing almond oil at different concentrations

3.5 Spread rate and specific gravity

As mentioned earlier Figure 9 revealed that the castor oil and almond oil behaved favourable in the paint samples as far as spread rate is concerned. Although when compared with the lead drier for the yellow paint sample the two plant extract oil exhibited low spread rate they both exhibited similar trend with the lead carbonate drier for the other colours of paint sample with almond oil performing far better than lead and castor oil for the white paint sample (Figure 9). In each case, castor oil contained sample paint displayed highest specific gravity while the lead contained paint sample displayed the lowest specific gravity, except for the yellow sample which almond oil contained paint sample displayed the highest specific gravity (Figure 8). The display of higher specific gravity by the paint samples containing plant seed oil may have been partly due to their individual specific gravity and their interaction with the other components of the paint sample. It was generally observed that the colour also affect the specific gravity of the paint samples (Figure 8).

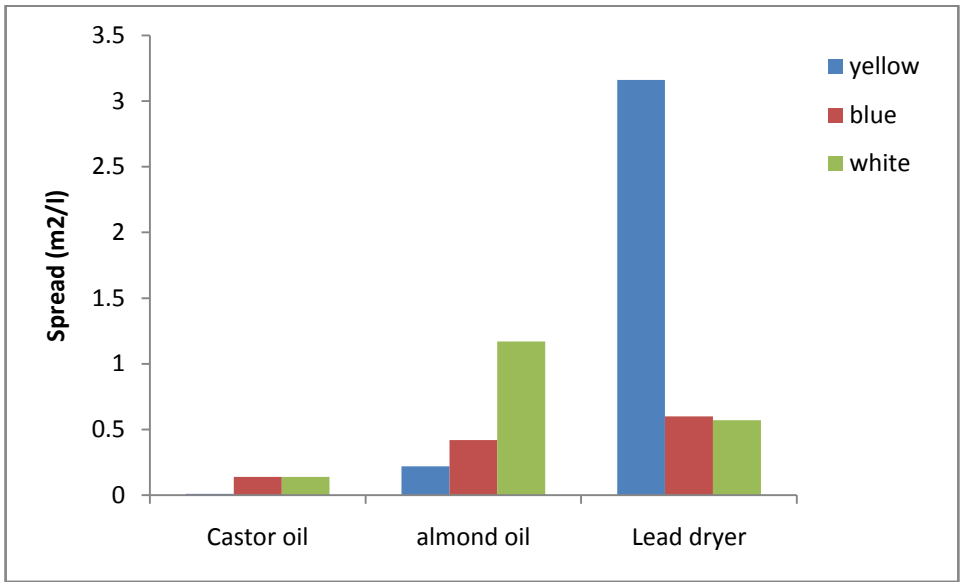

Figure 9. Spread rate of paint sample with various drier composition

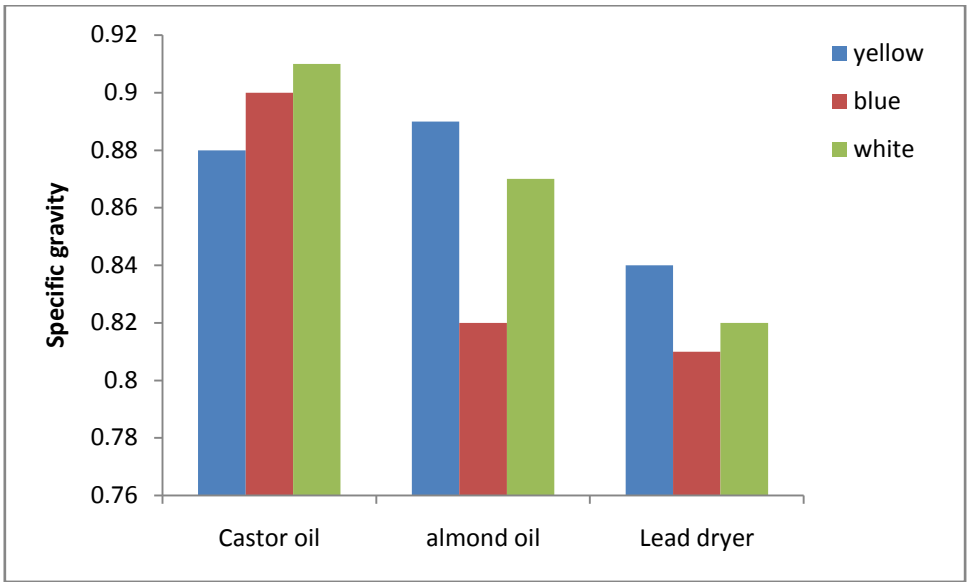

Figure 10. Specific gravity of paint sample with various drier compositions

IV. CONCLUSION

Castor and almond seed oil has been proved to be an alternative to the widely used, expensive, imported linseed oil, in paint making. Farmers are also encouraged to embark on the production of castor seed plant, considering its inexhaustible roles in oil paint making, medicine, cosmetics and other industrial applications. In conclusion, it is shown from the result that the properties of natural paint blend additives (Almond and castor seed oil) shows some better properties compared to lead-based paint. Hence, natural based paint drier can replace lead carbonate-based paint which is dangerous to nervous system when inhaled. The use of castor and almond seed oil as additives, in gloss paints are now strongly recommended, in order to check-mate release of greenhouse gases in lead carbonate blend additive paint, during paint drying which are hazardous to life.

Conflict of interest

There is no conflict to disclose.

REFERENCES

[1]. Daniel M, (2007), Standard Specification of Linseed Oil for Paints, Industrial Research and Standard Revision Acts, section 20(25), S.I.159/1949.
[2]. Ibemesi J, A and Attah J, C. (1990); Solvent Extraction of Oils of Rubber, Melon, Pumpkin and Oil Bean Seeds, American Oil Chemist's Society, 67(1), 25-27
[3]. Kalaiselvi P, B. Amuradha, C.S. Parameswari, (2003), Protective Effect of Ricinus Communis Leaf Extract against Paracetamol-induced Oxidation of Unsaturated Lipids, Hepato-toxicity, journal of, (1-2), 97-105.
[4]. Oguniyi D. S, (2006), Castor Oil; A Vital Industrial Raw Material, Bioresource Technology, 97(9), 1086- 1091.
[5]. Sabina E.P, M.K. Rasod, L. Matthew, (2009), Studies on the protective effect of Ricinus Communis Leaves Extract on Carbontetrachloride heptatotoxicity in Albino Rats, Pharmacology 2, 905-916.
[6]. Wollensak G, E. Spoerl, T.Seiler, (2003), Riboflavin/ultraviolet induced collagen cross linking for the treatment of kertoconus, American journal of Ophtalmol, 135 (5), 620- 627.

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