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Production of Tri-Color Printer Ink by Natural Pigment Extraction

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Abstract: The usage of inkjet printer is no doubt a paramount necessity for current society. This essential is rather expansive and overpriced that leads to this research which is to study an economical, simple, as well as bio friendly method in producing ink for printers. Used cooking oil was treated by filtering the oil from debris and the oil was heated with ginger for 2 hours. Ethanol was mixed with oil to remove polar substance before it is mixed with colour pigments. Tri colour ink that has been selected are yellow, red and blue. Yellow colour was extracted from turmeric herb (curcuma longa), red colour from roselle flower (Hibiscus sabdariffa) and finally blue colour from Asian pigeonwings flower (Clitoria ternatea). All of the plant was washed first to discharge any dirt, then it is dried to remove moisture and crushed to increase surface area for maximizing colour extraction. Water was used to extract the colour by allowing the solvent to percolate the plant for several hours. The extracted pigments will then be mixed with recovered used cooking oil at the ratio of 1:1. To test the efficiency of the ink produced, pH analysis, boiling point and testing of produced ink in a printer has been carried out. The result shows that the ink produced is as outstanding as commercial ink as it is acidic, possess high boiling point at 75°C and it was able to operate successfully by commercial Hewlett-Packard printer. It dries as fast, produce not just three main colour but as well as other colour that can be chosen from printing options in computer and as an added value, it is unexceptionally biofriendly to nature.

Key words: pigment extraction, used cooking oil, ink

1. Introduction

Printing starts way back during the first Chinese civilization. In a study conducted in 2012, ink stick dated 317–420 AD has been analyzed to study the main content which were pine soot while borneol and cedar oil was used as additives to enhance the ink stickiness performance (Wei et al., 2012). While later in Middle Ages until 20th century iron galls ink were used which includes drawings by artist Bach. However, the iron galls ink has corrosive properties that may cause paper deterioration throughout time (Kolar, 2012). While in this modern world, inkjet printers were developed from 1971 to late 1980 by Canon and Hewlett Packard who are still the inkjet printer provider until this day. During this period, ink material that was used includes water, colorant, resins and surfactants (Clymer & Asaba, 2008).

Pigments are colourant that is insoluble in most solvent but can dissolve in media when it is dispersed (Hao & Iqbal, 1997). Pigment can be classified into categories based on application, structure, and it can also be classified into synthetic inorganic and natural pigment. Natural pigments are made from renewable sources most often the pigments are extracted from plant material. Plant pigments and colourant has never reported toxicity

cases, safe for human consumption, eco-friendly and involves minimum hazardous chemical reaction. In addition to this, natural organic pigments offer efficient colouristic properties due to its natural occurrence (Abel, 1999). In this study, three pigments from three different plants have been extracted to produce three different colours. From these three main colour, any other colour can be produced by combinations of the three pigments.

Tumeric belongs to ginger family, Zingiberaceae that grows as roots and usually utilized as colourant and flavour enhancer in Asian cooking. This herb is mainly used in Indian subcontinent and it is reported to treat several diseases involving skin and wound healing (Aggarwal et al., 2007). Yellow colour provided by turmeric is interesting to be extracted as it possesses high ability to bind to any surface. Modern paint usually uses yellow azo-dye to provide this type of colour. While easy to obtain, benzene ring that is present in yellow azo-dye may cause harmful effect on health from prolonged use. Meanwhile this effect is almost absent in turmeric.

Roselle or Hibiscus sabdariffa L, an annual shrub with red flower that is easily found in Malaysia is used to provide red colour for the ink printer. This plant contains high medicinal value such as its ability to prevent cancer and lower blood pressure (Muhammad & Shakib, 1995). Apart from that it has been discovered that this flower contains high antioxidant activities (Norhaizan et al., 2010). These properties may lead to high stability when ink is produced.

The third colour that was produced from this study is blue that was extracted from Asian pigeon wings flower (Clitoria ternatea) or locally known as bunga telang. In cosmetic this plant is usually used as it is much safer for skins and human use. Apart from that, Asian pigeon wings flower is mainly used in food to provide blue colour. Normally blue pigments are collected from azurite mineral rocks that contains mainly copper.

The focus component in this study is to reuse waste and provide a green technology approach. To achieve this, used cooking oil is adopted as a base for making ink. Used cooking oil is mostly thrown away when it has served its purpose for cooking. This can cause water pollutants as oil has properties that may cause clogging of sewers. Meanwhile natural pigments from local plant are used to produce colour for the ink. Hence, objective of this project is to produce color pigment from natural resources which is turmeric, Asian pigeon wing flower and Roselle flower. Apart from this, used cooking oil is treated from household and a high quality of ink for inkjet printer is able to produce.

2. Methodology

2.1 Materials

Used cooking oil (palm oil) was collected at local household. All fresh natural plant for this study were purchased at the local market in Pasar Satok, Kuching. Ethanol used was a laboratory grade and purchased from Merck with 95% purity. While other chemicals were of highest purity and water used was distilled in lab.

2.2 Used Cooking Oil Recovery

Used cooking oil was strained using cheese cloth to remove coarse food particles. It is then heated to 50°C for several hours. Thinly sliced ginger is added to remove odour from the oil and left in the oil for several more hours. Ginger is used as it has ability to removed odour and recovers used cooking oil (Hafidzal et al. 2015).

Ethanol was mixed in used cooking oil and stored in an air tight container for separation to occur. The upper layer was collected to be mixed with pigments.

2.3 Plant Extraction

2.3.1 Blue Pigment Extraction

Asian pigeon wing flower was washed thoroughly to remove dirt and impurities. 25 ml of water was added to 50 g of flowers and let to soak. Treated oil was mixed with flower and water mixture for 3–4 hours. Flowers were percolated from produced ink.

2.3.2 Red Pigment Extraction

100 ml of water was mixed with Roselle flower and water was discarded. The flowers was then mixed with treated oil and stirred until foam starts to form. After the mixture is saturated with red colour, the flowers were discarded from oil solution.

2.3.3 Yellow Pigment Extraction

Turmeric skin was removed using spoon. It is then crushed using pastel and mortar to small pieces. 1000 ml of water was mixed with turmeric and recovered oil. The turmeric was extracted in oil and water mixture. After a concentrated yellow colour solution was obtained, the turmeric was removed. Two layer solutions were formed. Water was percolated and yellow oil was kept.

2.4 pH Analysis

pH meter Mettler Toledo has been used to determine the pH of market and produced ink. pH meter stick was dipped in ink sample and the readings was recorded. This process was repeated three times and an average reading was recorded.

2.5 Boiling Point

All of ink samples were heated using a magnetic heater. A mercury thermometer was dipped in the ink using retort stand. Temperatures were increased until ink starts to boil. The temperature at which ink boils was recorded. This process was repeated and an average values was taken.

2.6 Ink Testing

Printer used was Hewett and Packard (HP) model 2135. All of the three colours ink was injected in printer cartridge using syringe. The printer was assembled as usual and HP Envy laptop was connected to printer to be tested.

3. Results and Discussion

3.1 pH Analysis

Based on the analysis that has been done to the blue ink produce from Asian pigeon wing flower, pH reading shows that the ink is acidic with 5.4. The blue ink produce also have similarities with marketing ink because both are acidic with pH of 5.9. Next, for the yellow ink produce is neutral with the pH value 7.0. There is the difference with the marketing ink because this ink is acidic with pH value 5.5. Red ink from marketing and produce ink are acidic with pH value less than 7.0. Acidic medium is much preferred in ink making. Acid has antibacterial and anti-fungal properties that can prolong shelf life of ink. Therefore, the produced ink consists of properties similar to market ink and it can definitely perform as good.

Table 1 Comparison of pH Value between Market Ink and Produced Ink

	Product ink	Marketing ink
Sample	pH indicator	pH indicator
Blue Ink	5.4	5.9
Yellow Ink	7	5.5
Red Ink	6.1	5.7

3.2 Boiling Point

Boiling point of a substance is important to study its stability towards heat. If the ink has high boiling point, the ink may withstand the heat of printer when it is operated. Phase separation of ink and pigments is also important so that the ink produced has high shelf life. It is found out from boiling point studies that the ink produces has a consistent value. This is explainable as the base material in all colours was from the same materials. High boiling point is observed from the ink produced and the value is almost similar to market value.

Table 2 Comparison on Boiling Point of Commercial and Produced Ink

Sample	Product ink (°C)	Marketing ink (°C)
Blue Ink	75	78
Yellow Ink	75	79
Red Ink	75	81

3.3 Ink testing on Commercial Printers

The ink produced can be used in the printer tested. Several colours combinations were selected from computer and the printer filled with produced ink is able to produce colour according to selection. Ink produced was able to dry at a high rate leaving no ink stains on paper. About 80 pages of paper were able to be printed using this ink with astounding results. The printer itself does not show any rejection on the ink that has been injected. Ink levels in cartridge are also able to be detected by computer.

Waste material such as used cooking oil was able to be reused, hence increasing its value by producing a potentially marketable inkjet for printers. The results show that the produced printer ink was successfully done using natural pigment extraction and used cooking oil. pH value of market and produced ink was similar which is below or equal to 7 and thus possess same stability. Boiling point of produced ink was high at 75°C and the value was also very consistent. This shows that the produced ink may withstand the heat from printing process. Ink produced has also been tested on commercial printer and paper that shows that the ink produced can function as competitive as commercial ink.

4. Conclusion

Used cooking oil was able to be treated and used as a base for this study. While natural yellow, blue and red pigments from turmeric, Asian pigeon wing flower and Roselle flower were able to be extracted and mixed with used cooking oil to produce a functional inkjet for printers.

References

Abel A. (1999). *Paint and Surface Coatings* (2nd ed.), Lambourne, Woodhead Publishing.

Aggarwal B. B., Sundaram C., Malani N. and Ichikawa H. (2007). "Curcumin: the Indiansolid gold", *Adv. Exp. Med. Biol*., Vol. 595, pp. 1–75.

Clymer N. and Asaba S. (2008). "A new approach for understanding dominant design: The case of the ink-jet printer", *Journal of Engineering Technology Management*, Vol. 25, pp. 137–156.

Hafidzal M. H. M., Razi M. H. M., Hamzah A., Razak N. H., Zulkafli N. I., Abdollah M. F. B., Shamsudin S. A. and Roslizar A. (2015). "Potential of mixed zinger officinale and garcinia atroviridis as a treating medium for used cooking oil", *ARPN Journal of Engineering and Applied Sciences*, Vol. 10, No. 17, pp. 7784-7787.

Hao Z. and Iqbal A. (1997). "Some aspects of organic pigments", *Chemical Society Review*, Vol. 26, pp. 203-213.

Kolar J., Malesic J., Kocar D., Strlic M., Bruin J. D. and Kolesa D. (2012). "Characterization of paper containing iron gall ink using size exclusion chromatography", *Polymer Degradation and Stability*, Vol. 97, pp. 2212-2216.

Muhammad T. B. and Shakib A. B. (1995). "Jus hibiscus: Bukan sekadar minuman biasa", *Economic Hall*, pp. 12–14.

Norhaizan M. E., Fong S. H., Amin I. and Chew L. Y. (2010). "Antioxidant activity in different parts of roselle (Hibiscus sabdariffa L.) extracts and potential exploitation of the seeds", *Food Chemistry*, Vol. 122, pp. 1055–1060.

Wei S., Fang X., Yang J., Pintus V., Schreiner M. and Song G. (2012). "Identification of the materials used in an Eastern Jin Chinese ink stick", *Journal of Cultural Heritage*, Vol. 13, No. 4, pp. 448–452.