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Agar-Agar (Gelidium Corneum) as an Additive to an Emulsifying Agent in Photographic Silkscreen Printing

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ABSTRACT

This experimental study aimed to determine Agar-agar's acceptability (gelidium corneum) as an additive to an emulsifying agent in photographic silkscreen regarding adaptability, durability, and legibility. It also sought to ascertain its level of acceptability and determine if significant differences exist in the acceptability using the different treatment as rated by the learners, teachers, and practitioners and when the respondents grouped as a whole. The Iloilo Province participants' data purposively selected: students-74, teachers-15, and industry practitioners-18 interpreted and analyzed using Statistical Package for Social Science (SPSS). The result revealed that all participants positively accepted the four treatments but not differed in their evaluation. The overall ratings obtained had a verbal interpretation of "highly acceptable," which means that the four treatments are acceptable. The researcher recommended agar-agar as an additive to an emulsifying agent in photographic silkscreen printing in the academe and the Iloilo Province industry.

Keywords
agar-agar, gelidium corneum, emulsion, emulsifying agent, photographic silkscreen printing

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Introduction

"We do not learn from experience... we learn from reflecting on experience."
-John Dewey

According to Dewey, the universal idea of education is a continuous process (Williams, 2017). As facilitators, teachers have a vital role in making the learners learn to the utmost of their capabilities through analytical and critical discussions coming from their experiences. Notably, Higher Education Institutions (HEI) tasked to perform more than expected from the Basic Education Curriculum. In 2014, the Commission on Higher Education (CHED) mandated all HEI to use Outcomes-Based Education (OBE) in their teaching-learning processes (CHED Handbook, 2014). The objective of the OBE is to make the student the centre of the learning process. Thus, it gives the learner the essential learning domains to achieve the desired level of competencies in vision, mission, goals, and objectives (VMGO). On the part of the university's faculty, careful planning must attain each subject's intended learning outcomes that begin with designing the curriculum to achieve correct course outcomes (ISAT U Curriculum Manual, 2017).

The Bachelor in Industrial Technology (BIT) curriculum is the flagship curriculum of the College of Industrial Technology (CIT) of the Iloilo Science and Technology University (ISAT U). It offers various technical courses, and one of them is Architectural Drafting Technology (ADT). The ADT program allows students to develop their skills in making manually-prepared and computer-aided house plans and visual arts (Quality Procedure Manual of the University for Outcomes-Based Education, 2017). The Program further prepares students for entrance to and advancement in the industry's middle-level technical position between tradespeople in the workshops and the engineers or technologists (MECS Order No. 32, s. 1982). The graduates of the academy will become middle-level technicians who can work with minimal supervision. On the other hand, knowledge and technical skills must be addressed to meet the industry's demands, like sophisticated rendering programs and house planning using computer-aided drafting and printing shirts using advanced technology like heat press and sublimation colour separation process.

Ideally, as an ADT faculty as a mandate to deliver quality and practical instruction, developing a process, technology, and techniques is essential in providing the necessary and appropriate competencies needed by the ADT learner to work in the industry or become an entrepreneur later on.

Graphic arts is one of the subjects taught in the ADT students to become efficient and active workers in the advertising industry. One of the biggest industries where ADT student can apply their skills after graduation is to go to the advertising industry. One of the significant works there is t-shirt printing. Although modern machines introduced in the market, necessary printing skills such as film, cut-outs, and photographic Silkscreen widely used because of the adaptability, durability, and legibility feature.

There are a variety of printing methods and techniques that printing shops and enthusiasts practised. One of the conventional methods is the photographic printing method. This method uses a wet photographic emulsion applied to the screen. Typically, two or more coats are applied to embed the mesh—the entire screen exposed to a positive image. The unexposed areas of the stencil washed out with water. Then the processed screen is dried. Used a hand sprayer in the process of washing out the unexposed areas. During this activity, it takes time to spray out the stencil, and it is hard to eliminate the solution, and sometimes damages the stencil due to prolonged exposure to water. Thus, it delays the entire process of photographic printing. The researcher was motivated to conduct a study using the Agar-agar as an additive in photographic silkscreen printing to solve the problem within these views.

Literature

Printing and Developments

To understand the concept of silkscreen printing, we will review the history and development of printing when the printing press developed by the Chinese and further developed in Europe in the 15th Century, mass production of uniform printed matter, mainly text in the form of books, pamphlets and newspapers was massive (History, 2018). From this revolution, further developments on how to improve the printing process were the concern of everyone. According to Mine (2018), printing has nine main types: processes, offset lithography, engraving, thermography, reprographics, digital, letterpress, screen, flexography, and gravure. Screen printing is a universal business done by large printing companies and homes (Free News, 2003).

Furthermore, Rauscheberg & Warhol (2017) considered silkscreen printing the most versatile modern stencil technique used by commercial designers and by such artists. They express that this method – in which the passage of ink or paint through permeable screens of silk, nylon, or steel wire blocked by chemical treatment – enables artists to create more complex, sophisticated designs than is possible with ordinary cut-out stencil.

Silkscreen Printing

Free New translated the idea of screen printing (2003), an activity performed using a wooden frame with screen printing cloth stretched over it and a photo emulsion applied to the screen. Then, dried and exposed to a bright light source (a sunlight or bulb light) with a film positive (opaque paper or acetate) done in black colour positioned directly to the source of light at a certain period (usually 3 minutes). After the exposure, wash with running water, clean the unexposed part and apply it with a hardener. Now the silkscreen is ready for printing.

Beck, Peter, & Owens (1910) in Screenshotsinc.com (2017) studied and experimented with chromic acid salt sensitized emulsions for photo-reactive stencils. This trio of developers would prove to revolutionize the screen printing industry by introducing photo-imaged stencils to the industry, though adopting these methods would take many years.

According to the study of Gegantoni (1989), utilizing local materials and the developing process in making the photo stencil for silk screen printing can be prepared locally. Silkscreen printing is limited to the use of emulsion found in the market—their other emulsions made through research using locally available materials, which was found acceptable.

In the study conducted by Gabion (1999), he stressed that potassium dichromate as an agent in photographic silkscreen printing proved to be very satisfactory in terms of workability and resiliency of the stencil and legibility of prints.

On the other hand, in the study of Valenciana (1993), he utilized three brands of emulsions in the market to prepare photographic silkscreen printing, such as Tulco, Grafix, and Elmer's Glue.

The above-information discussed the demand for silkscreen printing, even though it was old technology. Due to its popularity, it is inevitable to set aside the printing process's usefulness; different studies prove that it is possible to use this

printing type using different emulsion types or even additives to get the desired result. As an educator, developing a study on how to improve ADT learners' knowledge and skill to become lifelong learners is an enormous contribution of the teacher in education.

Emulsion

Loeschen (2019) defines glue as one of the oldest and most versatile adhesives applied in liquid form and dries hard to hold materials together. It is made from organic compounds like animal collagen, but many products marketed as glue are synthetic adhesives made with polyvinyl acetate (PVA) emulsions. The polymer, called polyvinyl acetate, can be mixed into an emulsion to create a glue of the appropriate texture. PVA glues must have additives to prevent them from drying out immediately so that they can remain shelf-stable.

According to Elmers.com (2018), the glue is human-made or formulated from chemicals synthesized, obtained initially, or manufactured from petroleum, natural gas, and other raw materials found in nature.

There are many brands of emulsion found in the market today. Nevertheless, branded emulsions are expensive compare to Elmer's glue. Because of the availability and low price in the market, commonly glue used in photographic silkscreen printing. Despite the attributes of the glue, the problem existed during washing and use. Creating pinholes and even destroying the design of the stencil. These problems opted for the researcher to design an emulsion durable and resist tear even with continuous printing and frequent washing.

Why Agar-agar?

Chatelain (2012) defined Agar (or Agar Agar) as a gelling agent coming from a Southeast Asian seaweed. It is a filler in paper sizing fabric and as a clarifying agent in brewing. Besides, because of 80% fibre, it useful laxative and appetite suppressant. Furthermore, it is, of course, a unique culinary ingredient. It is a vegetarian gelatin substitute, a thickener for soups, fruit preserves, ice cream, and other desserts.

According to the Philippines Medicinal Plants (2017), agar-agar is one of the most common edible algae in the Philippines, manufactured for commercial agar-agar.

Spyropoulosa, Hancocks, & Norton (2011) defined emulsions constitute a significant component of many foods, yet emulsification processes have not changed in recent years, with droplet break-up systems at the forefront of food processing.

Arminsen and Galatas (2000); Pereira (2011) in Malcata, Pinto, & Guedes (2018) explained that agar is responsible for gelling while the latter has thickening properties.

Due to the versatility, availability, and applicability of the Agar-agar in the photographic silkscreen printing, it is in this context that the researcher wanted to improve the quality of the emulsion by making it more reliable and durable in continuous printing activity and frequent washing of the stencil.

Loeschen (2019) suggests that a more efficient option is a high shear disperser, like a kitchen blender drawing material up from beneath the mixing head and thrusting it through the blades to break apart polymer particles and mix the emulsion thoroughly.

Spyropoulosa, Hancocks, & Norton (2011) added that conventional emulsification processes such as rotor/stator high shear mixers and high-pressure homogenizers produce bulk emulsion comminution of the dispersed/internal phase. Such mechanical methods require significant inputs of energy and subject the emulsion to high shear and thermal stresses.

Objectives of the Study

This study deals with Agar-agar's acceptability as an additive to an emulsifying agent in photographic silkscreen printing. Specifically, this study aimed to answer the following questions:

1. What is the level of acceptability of Agar-agar as an additive used to an emulsifying agent in photographic silkscreen printing as to adaptability, legibility, and durability as rated by the students, teachers, and practitioners, and when the respondents grouped as a whole?
2. Is there a significant difference in Agar-agar's acceptability as an additive to an emulsifying agent in photographic silkscreen printing, using different adaptability, legibility, and durability?

Figure 1shows the conceptual framework of the study. It shows the independent variables were Agar-agar's four treatments as an additive to an emulsifying agent in photographic silkscreen printing. **Treatment A has a (1:2)** proportion with 1 cup emulsion and two tablespoons of Agar-agar. **Treatment B has (1:3)** proportion with 1

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cup emulsion and three tablespoons of Agar-agar. **Treatment C (1:4)** with 1 cup emulsion and four tablespoons of Agar-agar. **Treatment D (1:5)** with 1 cup emulsion and five tablespoons of Agar-agar. The dependent variables determine and identify which of the four treatments gives the best result in terms of adaptability, durability, and legibility as rated by the respondents.

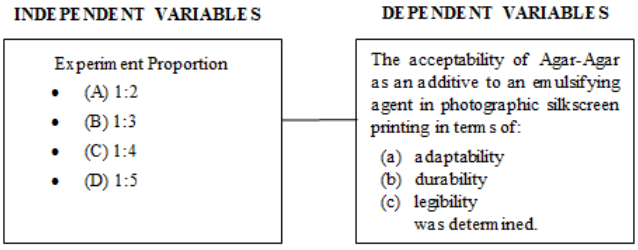


Figure 1: **Conceptual Framework of the Study.**

Methodology

The Study Scenario

This study used the experimental method of research. QuestionPro (2018) defined experimental research as any research conducted with a scientific approach, where a set of variables kept constant while the other set of variables measured as the subject of the experiment. The Completely Randomized Design (CRD) was used in this experimental study because it is appropriate for homogenous experimental.

Sampling

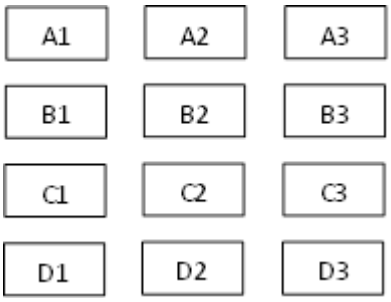
The scores from the three sets of evaluators for each product used. Each treatment is comprising of five drafting instructors of Western Visayas College of Science and Technology and ten teachers in the province of Iloilo with a total of fifteen and seventy-four (74) drafting students of the same school and eighteen (18) silkscreen practitioners in the city and province of Iloilo, Western Visayas in Summer 2017. These evaluators believed knowledgeable of the processes and criteria evaluated.

Evaluation Tools

A Five-Point Likert Scale score sheet was used as an instrument in data gathering and subjected to content validity by the five experts and tested to a group of 20 participants with the same characteristics and attributes as the study's target participant. Part 1 of the scoresheet asked the profile of the participants. Part 2 evaluates the Agar-agar acceptability as an additive to an emulsifying agent in photographic silkscreen printing. The number of items/questionnaires of the instruments are as follows: profile of the participants, 3; adaptability, 5; durability, 5; and legibility, 5. Furthermore, the instrument also contains open-ended questions which seek to gain additional information on the processes, techniques, and methods in preparing photographic silkscreen printing.

The Collection of the Data

The experiment has three phases, the preparation phase, the printing phase, and the evaluation phase. The materials were a wooden frame, 100 mesh silkscreen, and glue with agar-agar mixture in the preparation phase. The printing phase that the four treatments of moisture applied in the finished stencil used for three replications. The 12 printed t-shirts and 12 photographic stencils subjected to evaluation arranged using the Completely Randomized Design and evaluated by the respondents. During the evaluation phase, the evaluators used this experimental layout of the four treatments replicated three times each after randomly drawn using 1/8 long-sized bond paper in the box, shown in Figure 2.



Legend: *A=Treatment 1 with a ratio of 1:2; B=Treatment 2 with a ratio of 1:3; C=Treatment 3 with a ratio of 1:4; D=Treatment 4 with a ratio of 1:5*

Figure 2. The Experimental Layout of the Study.

The researcher secured permission from the offices of the faculty and owners of the printing industry. The researcher personally distributed and administered the instrument to the identified participants. The participants asked whether each item included was necessary to evaluate or determine Agar-agar's acceptability as an additive to an emulsifying agent in photographic silkscreen printing regarding adaptability, durability, and legibility of finished products.

Statistical Analysis of the Data

After the sensory evaluation of the finished product, the gathered data were encoded, summarized, tabulated, processed, analyzed, interpreted, and were computer-processed using Statistical Package for Social Science (SPSS) Version 22. A tally system used in the responses of the one hundred seven evaluators in every three replications. In analyzing the results, the researcher adopted the tally scheme for every item for statistical processes. Data regarding acceptability using four different treatments in terms of adaptability and durability were analyzed and interpreted using the weighted mean, t-Test for the independent sample mean, and One-Way Analysis of Variance (ANOVA) 0.01 level of significance.

Results and Discussion

Table 1. Acceptability of agar-agar as an additive to the emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the students

Treatment	Adaptability		Durability		Legibility		Over-all		Description
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
A	3.96	.50	4.00	.53	4.12	.58	4.03	.49	Highly Acceptable
B	3.95	.61	3.97	.50	4.03	.63	3.98	.50	Highly Acceptable
C	3.90	.55	3.96	.57	3.98	.61	3.95	.50	Highly Acceptable
D	3.93	.61	3.94	.57	4.02	.64	3.96	.55	Highly Acceptable

As shown in Table 1, treatments A, B, C, and D rated by the students as adaptability have 3.96, 3.95, 3.90, and 3.93, with the standard deviations of .50, .61, .55, and .61, respectively. Regarding durability, the means were 4.00, 3.97, 3.96, and 3.94, with the standard deviations of .53, .50, .57, and .57, respectively. As to legibility, the means were 4.12, 4.03, 3.98, and 4.02, respectively, and the standard deviations of .58, .63, .61, and .64, respectively. The obtained means on the students' overall evaluation were 4.03, 3.98, 3.95, and 3.96, respectively, with the standard deviations of .49, .50, .50, and .55 **Highly Acceptable**.

The findings conform to Gegantoni's (1989) study that utilizing local materials and developing the process to make the photo stencil for silk screen printing can be prepared locally. The degree of effectiveness of improvised photo-stencil proved satisfactory in terms of functionality, reliability, and durability.

Therefore, the students can use Agar-Agar as an additive in the photographic silkscreen printing processes because there is no significant difference in adaptability, durability, and legibility.

Table 2. Acceptability of agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the teachers

Treatment	Adaptability		Durability		Legibility		Over-all		Description
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
A	4.67	.40	4.59	.41	4.72	.34	4.66	.35	Very Highly Acceptable
B	4.69	.31	4.66	.36	4.67	.31	4.67	.27	Very Highly Acceptable
C	4.72	.35	4.62	.39	4.58	.45	4.64	.32	Very Highly Acceptable
D	4.71	.38	4.62	.41	4.47	.43	4.60	.35	Very Highly Acceptable

As shown in Table 2, five treatments rated by the teachers regarding adaptability have 4.67, 4.69, 4.72, and 4.71, respectively, with the standard deviations .40, .31, .35 .38. Regarding durability, the means were 4.59, 4.66, 4.62, and 4.62, respectively, with standard deviations of .41, .36, .39, and .41. As to legibility, the means were 4.72, 4.67, 4.58, and 4.47, respectively, and the standard deviations were .34, .31, .45, and .43, respectively. The obtained means on the teachers' overall evaluation were 4.66, 4.67, 4.64, and 4.60, respectively, with the standard deviations of .35, .27, .32, and .35, which is Very Highly Acceptable.

The result agrees with the study conducted by Gabion (1999), where he stressed that potassium dichromate as an agent in photographic silkscreen printing was very satisfactory in terms of workability and resiliency of the stencil and legibility of prints. In his study, sensitizer development using potassium dichromate is profitable and generates extra income for school

practitioners, a business venture to industry practitioners, silkscreen entrepreneurs, and enthusiasts.

Meaning, teachers can integrate this method into their subject so that they will have the chance to learn photographic silkscreen printing because it shows no significant difference in means of adaptability, durability, and legibility.

Table 3. Acceptability of agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the practitioners

Treatment	Adaptability		Durability		Legibility		Over-all		Description	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
A	4.38	.40	4.17	.42	4.21	.49	4.25	.28	Very Acceptable	Highly
B	4.40	.35	4.18	.48	4.24	.43	4.27	.26	Very Acceptable	Highly
C	4.37	.45	4.14	.49	4.07	.78	4.19	.39	Very Acceptable	Highly
D	4.39	.46	4.13	.44	4.14	.61	4.22	.31	Very Acceptable	Highly

As shown in Table 3, four treatments rated by the practitioners regarding adaptability have 4.38, 4.40, 4.37, and 4.39, respectively, with the standard deviations of .40, .35, .45, and .46. Regarding durability, the means were 4.17, 4.18, 4.14, and 4.13, with the standard deviations of .42, .48, .49, and .44, respectively. As to legibility, the means were 4.21, 4.24, 4.07, and 4.14, respectively, and the standard deviations were .49, .43, .78, and .61, respectively. The practitioners' overall evaluation has obtained means were 4.25, 4.27, 4.19, and 4.22, respectively, with the standard deviations of .28, .26, .39, and .31, which is Very Highly Acceptable.

In his study, Gabion (1999) shows conformity using different mixtures in preparation of photographic stencil and brands of emulsion and evaluated in terms of functionality, resiliency, and durability shows no significant difference in the performance of the stencil and quality of prints of T-shirts.

Hence, practitioners can use Agar-agar as an additive in the photographic silkscreen process because it adapts to any emulsion and is durable even with hundreds of prints and washings and legible because the prints on T-shirts are readable.

Table 4. Acceptability of agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the respondents when grouped as a whole

Treatment	Adaptability		Durability		Legibility		Over-all		Description
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
A	4.11	.52	4.11	.53	4.22	.58	4.15	.48	Highly Acceptable
B	4.10	.63	4.10	.53	4.15	.60	4.11	.49	Highly Acceptable
C	4.06	.57	4.08	.58	4.08	.65	4.07	.51	Highly Acceptable
D	4.08	.61	4.07	.58	4.10	.62	4.08	.53	Highly Acceptable

As shown in Table 4, four treatments rated by the respondents as adaptability have means of 4.11, 4.10, 4.06, and 4.08, with the standard deviations of .52, .63, .57, and .61, respectively. Regarding durability, the means were 4.11, 4.10, 4.08, and 4.07, with the standard deviations of .53, .53, .58, and .58, respectively. As to legibility, the means were 4.22, 4.15, 4.08, and 4.10, respectively, and the standard deviations were .58, .60, .65, and .62, respectively. The obtained means on the respondents' overall evaluation were 4.15, 4.11, 4.07, and 4.08, respectively, and the standard deviations of .48, .49, .51, and .53, which is Highly Acceptable.

Valenciana (1993) agrees that the three emulsions utilized in preparing photographic silkscreen printing such as Tulco, Grafix, and Elmer's Glue. The findings show no remarkable difference, and all it takes is the choice of emulsion. Agar-agar as

an additive to an emulsifying agent in photographic silkscreen printing is adaptable, durable, and legible, as rated by the respondents.

Table 5. A comparison of acceptability of agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the students

Comparison of Acceptability		Sum of Squares	df	Mean Square	F-value	φ-value	Sig
ADAPTABILITY	Between Groups	.139	3	.046	.137	.938	ns
	Within Groups	98.829	292	.338			
	Total	98.968	295				
DURABILITY	Between Groups	.171	3	.057	.191	.903	ns
	Within Groups	87.409	292	.299			
	Total	87.580	295				
LEGIBILITY	Between Groups	.848	3	.284	.745	.526	ns
	Within Groups	110.756	292	.379			
	Total	111.603	295				
OVER-ALL	Between Groups	.294	3	.098	.372	.773	ns
	Within Groups	76.876	292	.263			
	Total	77.170	.295				

**P < .01*

Table 5 shows a comparison of the acceptability of Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the students between each treatment showed that the adaptability has an F-value of .137 with a φ-value of .938 which is not significant. The null hypothesis is accepted. In terms of durability, the F-value is .191 with a φ-value of .903, which is not significant. The null hypothesis is accepted. Concerning the legibility, the F-value is .745 with a φ-value of .526, which is not significant. The null hypothesis is accepted. The over-all comparison shows that the F-value is .372 with a φ-value of .773, which is not significant. The null hypothesis is accepted.

In summary, the findings revealed no significant difference between the four treatments in the use of Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the students. Meaning, the effect of the four treatments of Agar-agar as an additive used as an emulsifying agent in photographic silkscreen printing is the same.

Valenciana (1993) conforms that photographic silkscreen textile printing using three brands of emulsion: its implication to drafting technology curriculum that T-shirt printing should be included in the curriculum and provide the students all the opportunities for gainful employment.

Intimately, photographic silkscreen can provide the students with all the opportunities for gainful employment. It may also serve as their source of living when they cannot find a job in the future because it shows no significant difference in terms of adaptability, durability, and legibility.

Table 6. A comparison of acceptability of agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the teachers

Comparison of Acceptability		Sum of Squares	df	Mean Square	F-value	φ-value	Sig
ADAPTABILITY	Between Groups	.025	3	.008	.062	.980	ns
	Within Groups	9.490	71	.134			
	Total	9.515	74				
DURABILITY	Between Groups	.039	3	.013	.083	.969	ns
	Within Groups	11.166	71	.157			
	Total	11.205	74				
LEGIBILITY	Between Groups	.786	3	.262	1.668	.182	ns
	Within Groups	11.159	71	.157			
	Total	11.945	74				
OVER-ALL	Between Groups	.070	3	.023	.209	.890	ns
	Within Groups	7.880	71	.111			
	Total	7.950	74				

*P < .01

Table 6 shows the comparison of the acceptability of Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the teachers between each treatment showed that the adaptability has an F-value of .062 with a φ-value of .980 which is not significant. The null hypothesis is accepted. The F-value is .083 with a φ-value of .969, which is not significant in terms of durability. The null hypothesis is accepted. About the legibility, the F-value is 1.668, with a φ-value of .182, which is not significant. The null hypothesis is accepted. The over-all comparison shows that the F-value is .209 with a φ-value of .890, which is not significant. The null hypothesis is accepted.

In summary, the findings revealed no significant difference between each of the four treatments in the use of Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as evaluated by the teachers. Meaning, the effect of the four treatments of Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing is the same.

The finding is in agreement with a study conducted by Gabion (1999) on potassium dichromate as an agent in photographic silkscreen printing wherein he uses different mixtures in preparation of photographic stencil as well as brands of emulsion and evaluated in terms of functionality, resiliency, and durability show no significant difference as to the performance of the stencil and quality of prints of T-shirts. Therefore, Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing can also use in the different mixture and different brands of emulsions.

Table 7. A comparison of acceptability of agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the practitioners

Comparison of Acceptability		Sum of Squares	df	Mean Square	F-value	φ-value	Sig
ADAPTABILITY	Between Groups	.010	3	.003	.020	.996	ns

	Within Groups	11.729	68	.172			
	Total	11.740	71				
DURABILITY	Between Groups	.030	3	.010	.048	.986	ns
	Within Groups	14.212	68	.209			
	Total	14.242	71				
LEGIBILITY	Between Groups	.322	3	.107	.304	.822	ns
	Within Groups	24.009	68	.353			
	Total	24.331	71				
OVER-ALL	Between Groups	.065	3	.022	.221	.881	ns
	Within Groups	6.691	68	.098			
	Total	6.756	71				

*P < .01

Table 7 shows a comparison of Agar-agar's acceptability as an additive to an emulsifying agent in photographic silkscreen printing concerning adaptability, durability, and legibility as rated by the practitioners between each treatment regarding the adaptability; the F-value of .020 with a φ-value of .996 which is not significant. The null hypothesis is accepted. In terms of durability, the F-value of .048 with a φ-value of .986, which is not significant. Concerning the legibility, the F-value of .304 with a φ-value of .822, which is not significant. The overall comparison shows that the F-value is .221 with a φ-value of .881, which is not significant. Both null hypotheses are accepted.

In summary, the findings revealed no significant difference between the four treatments in the use of Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as evaluated by the practitioners. As implied, the effect of Agar-agar's four treatments as an additive to an emulsifying agent in photographic silkscreen printing is the same.

The study conducted by Gegantoni (1989) agrees that the photo-stencil solution is an improvisation silkscreen printing. Gabion's (1999) study on potassium dichromate as an agent in photographic silkscreen printing also conforms to this study's findings. The same as agar-agar as an additive to an emulsifying agent in photographic silkscreen printing is also a local material and abundant in our country. Using this material can be easily prepared as long as they have the proper knowledge about photo-emulsion preparation.

Table 8. A comparison of acceptability of agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the respondents when grouped as a whole

Comparison of Acceptability		Sum of Squares	df	Mean Square	F-value	φ-value	Sig
ADAPTABILITY	Between Groups	.125	3	.042	.123	.947	ns
	Within Groups	143.464	424	.338			

	Total	143.588	427				
DURABILITY	Between Groups	.135	3	.045	.145	.933	ns
	Within Groups	132.095	424	.312			
	Total	132.230	427				
LEGIBILITY	Between Groups	1.314	3	.438	1.160	.324	ns
	Within Groups	160.079	424	.378			
	Total	161.393	427				
OVER-ALL	Between Groups	.360	3	.120	.473	.701	ns
	Within Groups	107.447	424	.253			
	Total	107.807	427				

*P < .01

Table 8 shows a comparison of the acceptability of Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the respondents between each treatment showed that the adaptability has an F-value of .123 with a φ-value of .947 which is not significant. The null hypothesis is accepted. In terms of durability, the F-value is .145 with a φ-value of .933, which is not significant. Concerning legibility, the F-value of 1.160 with a φ-value of .324, which is not significant. The overall comparison shows that the F-value of .473 with a φ-value of .701 is not significant. Both null hypotheses are accepted.

In summary, the findings revealed no significant difference between the four treatments in the use of Agar-agar as an additive to an emulsifying agent in photographic silkscreen printing as to adaptability, durability, and legibility as rated by the respondents because printing is the same.

The studies conducted by Gegantoni (1989) and Gabion (1999) improved photo-stencil solution by adding potassium dichromate as an agent in photographic silkscreen printing. Agar-agar is an additive safe to use by the students, teachers, and practitioners because there is no significant difference as rated by them.

Conclusions and Recommendations

This study that aimed to determine the acceptability of Agar-agar as an additive to an emulsifying agent in photographic silkscreen as to adaptability, durability, and legibility as rated by the students, teachers, practitioners and when the respondents grouped as a whole was **highly acceptable** and revealed further that no significant difference in the level of acceptability of the four treatments.

Based on the findings and conclusions of this study, the researcher recommends the following:

- To the students making photographic silkscreen process for the commercial purpose to gain a high profit

, the additive is locally found and easy to prepare;

- Teachers should utilize the Agar-agar in the demonstration classes, particularly in photographic printing fundamentals, because it is safe and natural;
- To the practitioners, agar-agar is an alternative to the branded emulsion due to the speedy processing and same result given to the printing output;
- To the printing industry to prepare emulsion using Agar-agar as an additive to promote high-quality emulsion using local materials at a low price for silkscreen processing; and

- The entrepreneurs are to engage in Agar-agar culture and the technology in using the indigenous material as an additive be improved and produced on a large scale for consumers' use.

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