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Lab Report 3: Blood Typing and Population

Abstract: The purpose of this lab was to identify and examine the ABO and Rh blood types by the presence of agglutination. A positive reaction would indicate agglutination and the blood type, while a negative reaction would not agglutinate at all. A synthetic blood kit was used to perform the blood typing tests and determine the ABO and Rh properties. The collected blood sample data was then used to compare and report for the blood group frequency. The Hardy-Weinberg principle was used to determine the allele and genotype frequency in a population and check whether this principle is applicable. As a result, the Hardy-Weinberg principle does not apply to the sample population problem given since there is a presence of gene flow and genetic drift within the population. This is significant in the understanding of gene evolution and genetic variation.

Introduction: Humans have four blood types: A, B, AB, and O. Each blood type has specific antigens attached on the red blood cells. In addition, each blood type reacts with a certain antibody in the plasma. Blood type A has antigens A on the red blood cells and antibodies B in the blood plasma. Blood type B has B antigens on the red blood cells and antibodies A in the blood plasma. Type AB blood has both Type A and Type B antigens, but no antibodies present in the blood plasma. Type AB blood is known as the “universal receiver”, since there is no presence of antibodies that would recognize the surface antigens. No reaction will occur from receiving other blood types. Type O blood has no antigens present on the red blood cells but has both Type A and Type B antibodies in the blood plasma. Type O blood is known as the “universal donor”, as they do not contain any antigen. This analysis of ABO blood type is crucial when performing transfusions and transplantations, since each blood type reacts with only certain blood types. Normally, an individual with blood Type B will have antibodies against Type A blood. If a transfusion of Type A blood was given, the A antibodies in the individual’s blood will bind to the Type A antigen of the transfused blood and the red blood cells will agglutinate. The agglutination of the red blood cells can block the blood vessels, and eventually lead to death.

The ABO blood group is encoded by three different alleles, I^A , I^B , and i . Everyone receives a combination of the two alleles, one from each parent. The genotype of each allele controls the phenotypic expression of the ABO blood group. The A and B alleles are codominant, meaning that both phenotypes are expressed in heterozygotes. The i allele is recessive and individuals with Type O blood must have both copies to express the phenotype. The genotypic and phenotypic ratios are used to calculate the blood type percentages and determine the genetic frequency of a population.

Methods: Students in pair were given a synthetic blood kit. Three blood samples (6,7,8) were selected to perform the blood typing tests. A dropper vial was used to place a drop of the first synthetic blood sample in each well of the assigned blood typing slide. A new dropper vial was replaced for each sample, to prevent cross contamination. A drop of synthetic anti-A serum was added to the well labeled A. Then, a drop of synthetic anti-B serum was added to the well labeled B. Lastly, a drop of synthetic anti-Rh serum was added to the well labeled Rh. A new stick was used for each well to mix the synthetic blood and anti-serum together. The stick was discarded after to avoid contamination with other blood samples. Each blood typing slide were carefully examined to check for any positive or negative agglutination reaction. Data was recorded to calculate the blood group frequency and compared it with the given sample problem of blood group frequency. The Hardy-Weinberg equation was used to calculate the allele and genotype frequency of each blood type. The

allele frequency of a dominant allele is identified as p . The allele frequency of a recessive allele is identified as q . The sum of p and q equals to 1. The genotypic frequency of a homozygous dominant is identified as p^2 ; heterozygous as $2pq$; and homozygous recessive as q^2 . Therefore, $p^2 + 2pq + q^2 = 1$ since there are only two alleles and the sum of three genotype frequency equals to 1.

Results: Sample 6 appeared granular and clumpy on blood type A when anti-serum A drops was added. There was no reaction when both anti-serum B and Rh were added to the corresponding well. Therefore, sample 6 is blood type A-, with antibodies B and Rh. Sample 7 showed agglutination on blood type O when anti-serum Rh was added. There was no reaction when both anti-serum A and B were added. Therefore, sample 7 is blood type O+, with antibodies A and B. Sample 8 showed no signs of agglutination in each well. Therefore, sample 8 is blood type O-, with antibodies A, B, and Rh. Lastly, the calculations using the Hardy-Weinberg principle indicated that the genotypic frequency of the native population from the island is 80% ($i = 64\% \rightarrow \sqrt{0.64} = 0.8 \times 100 = 80\%$), while half the population is Rh+ and Rh-.

Table I:

Blood Group	Total for the Blood Group	Blood Group Frequency %
A+	5	15%
A-	10	29%
B+	5	15%
B-	3	8%
AB+	2	6%
AB-	0	0%
O+	4	12%
O-	4	12%

Table II:

Blood Type	Genotype	Expected Frequencies	Observed Frequencies
A	$I^A I^A$	12%	44%
B	$I^B I^B$	12%	23%
AB	$I^A I^B$	12%	6%
O	ii	64%	24%
Rh+	$r^+ r^+$	75%	50%
Rh-	$r^- r^-$	25%	50%

Discussion: A total of 34 samples were used to examine the ABO blood group. The blood group frequencies were calculated by dividing the total for the blood group/ total tested x 100. These results were then compared with the given sample problem. Based on the result, the observed data for Type O blood was 24% and the expected data for Type O blood was 64%. The chi square was analyzed to check the consistency of the results. Thus, proving that there is a genetic variation within the people in the island. This experiment supports the interpretation of the tradition, that the people who inhabited the island, were blood type O and introduced their blood type to the population. According to Brooker, a smaller population will lead to a larger genetic drift, and the ability for the population to adjust to changes in its environment (2016). Therefore, this refutes the Hardy-Weinberg principle.

References:

Brooker, R. J. (2016). *Concepts of genetics*. New York, NY: McGraw Hill Education.