Neutrosophic Sets and Systems, Vol. 60, 2023
University of New Mexico

Examples of NeutroHyperstructures on Biological Inheritance

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Abstract: : In 1934, Marty introduced the concept of hyperstructures, which serves as a generalization of algebraic structures. Hyperstructures have applications in various fields, including biology, where they prove useful for analyzing the different types of hyperstructures in inheritance. On the other hand, NeutroHyperstructures combine Neutrosophic sets with hyperstructures, offering a promising avenue to handle uncertainty in inheritance analysis. Inspired by the intriguing variety of hyperstructures observed in inheritance phenomena, this paper takes on the purpose of thoroughly examining the types of NeutroHyperstructures present in multiple biological inheritance examples. The study focuses on analyzing inheritance patterns in Mirabilis Jalapa flowers, Shorthorn Cattle coat color, and blood types (ABO, ABO with rhesus, MN, MN with rhesus, and the Kidd system) through the lens of NeutroHyperstructures. Through this meticulous analysis, the research aims to contribute significant insights into the genetic inheritance processes, unveiling the role of NeutroHyperstructures in governing diverse biological traits. The findings offer valuable implications for the field of mathematical biology, presenting novel perspectives on inheritance modeling and establishing the potential of NeutroHyperstructures to effectively address uncertainty in genetics and inheritance studies. This study fosters a deeper understanding of complex biological inheritance and opens new avenues for practical applications in the realm of genetics and related disciplines.

Keywords: Biological Inheritance; Hyperstructures; Hypergroup; NeutroHyperstructures; NeutroHypergroup

1. Introduction

In 1995, Smarandache introduced the notion of Neutrosophy as a new branch in philosophy. Initially, ideas were seen as either "True" or "False". However, in neutrosophic concepts, ideas can be viewed as "True", "False" or "Indeterminate". One of the research related to neutrosophic sets is the neutrosophic quadruple set on algebraic structures [1-2]. Neutrosophic sets find many applications in various fields, including on Economics [3], supply chain [4], and operations research [5]. As neutrosophic research develops, these concepts can be applied to abstract structures. One such research development is NeutroAlgebra, introduced by Smarandache in 2019 [6 - 7]. In the NeutroAlgebra concept, operations are partially well-defined, partially false, and partially indeterminate, while axioms is partially true, partially false, and partially indeterminate.

On the other hand, in 1934 Marty introduced the concept of hyperstructures, a generalization of algebraic structures [9]. By applying the concept of neutrosophy to hyperstructures, a new concept called NeutroHyperstructures was defined [10-11]. on of the research developments in

NeutroHyperstructures is the definition of LA-Hyperstructures by Mirvakili, et al., namely Neutro-LA-Semihypergroup and Neutro-H_v-Semihypergroup [12].

Furthermore, hyperstructures have numerous applications in different fields including Physics [13], Chemistry [14], and Biology [15 – 16]. Inspired by NeutroHyperstructures and the applications of hyperstructures in Chemistry, the authors studied the applications of NeutroHypestructures in Chemical reactions [17].

This paper aims to analyze the types of NeutroHyperstructures in several examples of biological inheritance. The examples examined in this paper include Mirabilis Jalapa flowers, coat color of Shorthorn Cattle, ABO blood type, ABO with rhesus, MN, MN with rhesus, and kidd system. This paper is organized as follows: After the Introduction, Section 2 presents the basic theories used in this study. In Section 3 we analyze the NeutroHyperstructures contained in Biological Inheritance, focusing on examples like Mirabilis Jalapa flowers, coat color of Shorthorn Cattle, ABO blood type, ABO with rhesus, MN, MN with rhesus, and Kidd system. Finally, in Section 4 we provide the conclusion based on the results of the research conducted.

2. Preliminaries

In this section, we recall some concepts of NeutroHyperstructures taken from Ibrahim and Agboola [10] and Al-Tahan et al. [11].

Definition 2.1 [11] Let G be a nonempty set and "$\boxminus$" be a hyperoperation in G. Then the operation "$\otimes$" is called a NeutroHyperoperation in G if some (or all) of the following conditions are satisfied with $(T, I, F) \notin \{(1,0,0), (0,0,1)\}$.

1. There exist $p, q \in G$ with $p \otimes q \subseteq G$ (degree of truth "T")
2. There exist $p, q \in G$ with $p \otimes q \nsubseteq G$ (degree of falsity "F")
3. There exist $p, q \in G$ with $p \otimes q$ is indeterminate in G (degree of indeterminacy "I")

Example 2.2 Let $G = \{u, v, w\}$ and define a hyperoperation "$\otimes$" as follows.

Table 1. $(G,\otimes)$

$\otimes$	u	v	w
u	u	?	$\{u, w\}$
v	?	v	$\{v, w\}$
w	$\{u, w\}$	$\{v, w\}$	v

Then, $(G,\otimes)$ is a NeutroHyperoperation because there exist $u, v \in G$ such that $u \otimes v$ is indeterminate.

Definition 2.3 [11] Let G be a nonempty set and "$\otimes$" be a hyperoperation in G. Then "$\otimes$" is called *AntiHyperoperation* in G if for every $p, q \in G, p \otimes q \nsubseteq G$.

Example 2.4 Based on Example 2.2, $(\{u, w\},\otimes)$ is an AntiHyperoperation since $w \otimes w = v \nsubseteq \{u, w\}$.

Definition 2.5 [11] Let G be a nonempty set and "$\otimes$" be a hyperoperation on G. Then "$\otimes$" is called NeutroAssociative on G if there exist $p, q, r, x, y, z, a, b, c \in G$ that satisfiy some (or all) of the following conditions with $(T, I, F) \notin \{(1,0,0), (0,0,1)\}$.

1. $p \otimes (q \otimes r) = (p \otimes q) \otimes r$ (degree of truth "T")
2. $x \otimes (y \otimes z) \neq (x \otimes y) \otimes z$ (degree of falsity "F")
3. $a \otimes (b \otimes c)$ is indeterminate or $(a \otimes b) \otimes c$ is indeterminate (degree of indeterminacy "I")

Example 2.6 Based on Example 2.2, $(G,\otimes)$ is NeutroAssociative since there exists $u, v, w \in G$ such that $u \otimes (v \otimes w)$ is indeterminate.

Definition 2.7 [11] Let G be a nonempty set and "$\otimes$" be a hyperoperation in G. Then "$\otimes$" is called NeutroWeakAssociative in G if there exists $a, b, c, x, y, z, p, q, r \in G$ that satisfy some (or all) of the following conditions with $(T, I, F) \notin \{(1,0,0), (0,0,1)\}$.

1. $[a \otimes (b \otimes c)] \cap [(a \otimes b) \otimes c] \neq \emptyset$ (degree of truth "T")
2. $[x \otimes (y \otimes z)] \cap [(x \otimes y) \otimes z] = \emptyset$ (degree of falsity "F")
3. $p \otimes (q \otimes r)$ is indeterminate or $(p \otimes q) \otimes r$ is indeterminate (degree of indeterminacy "I")

Example 2.8 Based on Example 2.2, $(G,\otimes)$ is NeutroWeakAssociative since there exists $u, v, w \in G$ such that $u \otimes (v \otimes w)$ is indeterminate.

Definition 2.9 [11] Let G be a nonempty set and "$\otimes$" be a hyperoperation in G. Then $(G,\otimes)$ is called a NeutroHypergroupoid if "$\otimes$" is a NeutroHyperoperation, a NeutroSemihypergroup if "$\otimes$" is NeutroAssociative but not an AntiHyperoperation, and Neutro H_v-semigroup if "$\otimes$" is NeutroWeakAssociative but not an AntiHyperoperation.

Definition 2.10 [10] A NeutroHypergroupoid $(G,\otimes)$ is called a NeutroHypergroup if G is a NeutroSemihypergroup and there exist $e, f, g \in G$ that satisfy some (or all) of the following conditions with $(\mathrm{T}, \mathrm{I}, \mathrm{F}) \notin \{(1,0,0), (0,0,1)\}$. (This following condition is called a NeutroReproduction axiom).

1. $e \otimes G = G \otimes e = G$ (degree of truth "T")
2. $f \otimes G \neq G \otimes f \neq G$ (degree of falsity "F")
3. $g \otimes G$ or $G \otimes g$ indeterminate (degree of indeteminacy "I")

Example 2.11 Let $H = \{f, y, m\}$. Define a hyperoperation "$\otimes$" as follows.

Table 2. $(H,\otimes)$

$\otimes$	f	y	m
f	f	$\{f, y\}$	m
y	f	y	y
m	$\{f, m\}$	y	m

One can easily see that $(H,\otimes)$ is a NeutroHypergroup.

3. Main Results

In this section, the results of the research obtained are presented. In this section, "$\boxplus$" is defined as the result of mating.

Based on [16], in the case of flower color inheritance in the four o'clock plant (*Mirabilis Jalapa*), suppose R, P, and W respectively represent the color of the flowers of *Mirabilis Jalapa* namely red, pink, and white. Let $G = \{R, P, W\}$, the result of $(G,\boxplus)$ is given as follows.

Table 3. $(G,\boxplus)$

$\boxplus$	R	P	W
R	R	$\{R, P\}$	P
P	$\{R, P\}$	G	$\{R, P\}$
W	P	$\{R, P\}$	W

Theorem 3.1 $(G,\boxplus)$ is a NeutroHypergroup.

Proof. It is clear that $(G,\boxplus)$ is not an Antihyperoperation. Next, $P \boxplus (P \boxplus P) = (P \boxplus P) \boxplus P = G$, an $R \boxplus (W \boxplus W) = P \neq \{R, P\} = (R \boxplus W) \boxplus W$. Then, $(G,\boxplus)$ is a NeutroSemihypergroup. Furthermore, for every $P \in G, P \boxplus G = G \boxplus P = G$, $R \boxplus G = G \boxplus R \neq G$. Thus, $(G,\boxplus)$ is a NeutroHypergroup.

Remark 3.2 Based on [16], $(G,\boxplus)$ is not a NeutroH_v-semigroup because G is a H_v-semigroup. Clearly, there exists no element in G that satisfies falsify or the indeterminacy for NeutroH_v-semigroup.

Furthermore, based on [16], in the case of coat color inheritance of Shorthorn Cattle, suppose R, G, and W represent the colors of the Shorthorn Cattle coat, which respectively state red, reddish gray, and white. Let $K = \{R, G, W\}$, the result of $(K,\boxplus)$ is given as follows.

Table 4. $(K,\boxplus)$

$\boxplus$	R	G	W
R	R	$\{R, G\}$	G
G	$\{R, G\}$	K	$\{G, W\}$
W	G	$\{G, W\}$	W

Theorem 3.3 $(K,\boxplus)$ is a NeutroHypergroup.

Proof. It is clear that $(K,\boxplus)$ is not an Antihyperoperation. Next, $G \boxplus (G \boxplus G) = (G \boxplus G) \boxplus G = K$ and $R \boxplus (W \boxplus W) = G \neq \{G, W\} = (R \boxplus W) \boxplus W$. Then, $(K,\boxplus)$ is a NeutroSemihypergroup. Furthermore, $R \boxplus K = K \boxplus R \neq K$ and $G \boxplus K = K \boxplus G = K$. Thus, $(G,\boxplus)$ is a NeutroHypergroup.

Remark 3.4 $(K,\boxplus)$ is not a NeutroH_v-semigroup. The reason is same as in Remark 3.2.

Next, we want to analyze NeutroHyperstructures in the inheritance of traits from blood groups including the ABO, MN, ABO with Rhesus, MN with Rhesus systems, and Kidd System.

The ABO blood group system was introduced by Karl Landsteiner in 1900 [18]. Based on [16], suppose $M = \{O, A, B, AB\}$ represents the set of ABO system blood groups. The result $(M,\boxplus)$ is given as follows.

Table 5. $(M,\boxplus)$

$\boxplus$	O	A	B	AB
O	O	$\{O, A\}$	$\{O, B\}$	$\{A, B\}$
A	$\{O, A\}$	$\{AB, O, A\}$	M	$\{AB, A, B\}$
B	$\{O, B\}$	M	$\{O, B\}$	$\{AB, A, B\}$
AB	$\{A, B\}$	$\{AB, A, B\}$	$\{AB, A, B\}$	$\{AB, A, B\}$

Theorem 3.5 $(M,\boxplus)$ is a NeutroHypergroup.

Proof. It is clear that $(M,\boxplus)$ is not an Antihyperoperation. Next, $O \boxplus (O \boxplus O) = (O \boxplus O) \boxplus O$ and, $O \boxplus (A \boxplus AB) = \{O, A, B\} \neq \{A, B, AB\} = (O \boxplus A) \boxplus AB$. Then, $(M,\boxplus)$ is a NeutroSemihypergroup. Furthermore, $A \boxplus M = M \boxplus A = M$ and $O \boxplus M = M \boxplus O \neq M$. Thus, $(M,\boxplus)$ is a NeutroHypergroup.

Theorem 3.6 Let $M' = \{O, A, B\}$ and $M" = \{O, B, AB\}$. Then $(M',\boxplus)$ is a NeutroSubhypergroup and $(M",\boxplus)$ is a NeutroSemihypergroup.

Proof. First, we want to show that $(M',⊞)$ is a NeutroSemihypergroup. It is clear that $(M',⊞)$ is not an Antihyperstructure. Next, from Theorem 3.5, we can deduce that $(M',⊞)$ is a NeutroSemihypergroup. Next, $O ⊞ M' = M' ⊞ O = M'$ and $B ⊞ M' = M' ⊞ B \neq M$. Thus, $(M',⊞)$ is a NeutroSubhypergroup. Next, we want to show that $(M",⊞)$ is a NeutroSemihypergroup. Next, $B ⊞ (B ⊞ B) = (B ⊞ B) ⊞ B$ and for every $O ⊞ (O ⊞ AB) = \{O, A, B\} \neq \{A, B\} = (O ⊞ O) ⊞ AB$.Thus, $(M",⊞)$ is a NeutroSemihypergroup.

Remark 3.7 $(M",⊞)$ is not a NeutroSubhypergroup since it does not satisfy the NeutroReproduction axiom.

Theorem 3.8 Let $M_3 = \{A, B, AB\}$. Then, $(M_3,⊞)$ is a NeutroSubhypergroup
Proof. The proof is similar to that of Theorem 3.5.

Furthermore, we want to include the rhesus factor in the ABO blood group system. The rhesus (Rh) blood group system was discovered by Karl Landsteiner and Alexander S. Wiener in 1940 [19]. Let $M = \{O, A, B, AB\}$ represent the set of ABO blood group system, and $R = \{Rh^+, Rh^-\}$ is represent the rhesus set. We obtain the ABO blood group set with rhesus

$$N = M \times R = \{O^-, O^+, A^-, A^+, B^-, B^+, AB^+, AB^-\}.$$

$(N,⊞)$ is presented by Table 8. Based on Table 8, we have the following result.

Theorem 3.9 $(N,⊞)$ is a NeutroHypergroup.
Proof. It is clear that $(N,⊞)$ is not an AntiHyperoperation. Next, $O^- ⊞ (O^- ⊞ O^-) = (O^- ⊞ O^-) ⊞ O^-$ and $O^+ ⊞ (AB^- ⊞ AB^-) = \{A^+, A^-B^+, B^-O^+, O^-\} \neq \{AB^+, AB^-, A^+, A^-, B^+, B^-\} = (O^+ ⊞ AB^-) ⊞ AB^-$. Then, $(N,⊞)$ is a NeutroSemihypergroup. Now $A^+ ⊞ N = N ⊞ A^+ = N$ and $B^- ⊞ N = N ⊞ B^- = N$. Thus, $(N,⊞)$ is a NeutroHypergroup.

Theorem 3.10 Let $N_1 = \{O^+, O^-, A^-\}$. Then, $(N_1,⊞)$ is a NeutroHypergroup.

Table 6. $(N_1,⊞)$

⊞	O^+	O^-	A^-
O^+	O^+ O^-	O^+ O^-	A^+ A^- O^+ O^-
O^-	O^+ O^-	O^-	A^- O^-
A^-	A^+ A^- O^+ O^-	A^- O^-	A^- O^-

Proof. $O^+ ⊞ (O^+ ⊞ A^-) = O^+ ⊞ \{A^+, A^-, O^+, O^-\} =$ undefined since $O^+ ⊞ A^+$ is undefined. So, $(N_1,⊞)$ satisfies the degree of indeterminacy axiom for NeutroAssociative. Therefore, $(N_1,⊞)$ is a NeutroSemihypergroup. To prove the NeutroReproduction Axiom, it is similar to Theorem 3.9. Thus, $(N_1,⊞)$ is a NeutroHypergroup.

Remark 3.11 Based on Table 8, it is obvious that $(\{O^+, O^-, B^-\},⊞)$ is a NeutroHypergroup.

Theorem 3.12 Let $N_2 = \{O^+, O^-, A^+, A^-, B^-\}$. Then, $(N_2,⊞)$ is a NeutroHypergroup.
Proof. The proof is similar to that of Theorem 3.10.

Theorem 3.13 Let $N_3 = \{O^+, O^-, A^+, A^-, B^+, B^-\}$. Then, $(N_3,⊞)$ is a NeutroHypergroup.
Proof. The proof is similar to that of Theorem 3.10.

Next, we want to investigate the NeutroHyperstructures related to the MN blood group. This blood group system was discovered by Karl Landsteiner and P. Levine in 1927 [15]. Suppose X is the set of possible blood types possessed by the marriage of two individuals, namely $X = \{M, N, MN\}$. $(X,\boxplus)$ is presented in Table 9.

Theorem 3.14 $(X,\boxplus)$ is a NeutroHypergroup.
Proof. The proof is similar to that of Theorem 3.10.

Furthermore, we want to include the rhesus factor in the MN blood group. Let $X = \{M, N, MN\}$ and $R = \{Rh^+, Rh^-\}$. We get $P = X \times R = \{M^+, M^-, N^+, N^-, MN^+, MN^-\}$. $(P,\boxplus)$ is presented in Table 10.

Theorem 3.15 $(P,\boxplus)$ is a NeutroHypergroup.
Proof. The proof is similar to that of Theorem 3.10.

Next, we want to analyze the NeutroHyperstructures contained in the Kidd blood group. Kidd blood group was discovered in 1951 in a patient named Mrs. Kidd [20]. The phenotypes of the Kidd blood group are as follows.

Table 7. Phenotypes of Kidd Blood Groups [20]

Phenotypes	Frequency
$Jk^{(a+b+)}$	**50% Caucasians**, 41% Blacks, 49% Asians
$Jk^{(a+b-)}$	26% Caucasians, **51% Blacks**, 23% Asians
$Jk^{(a-b+)}$	23% Caucasians, 8% Blacks, **27% Asians**
$Jk^{(a-b-)}$	**0.9% Polynesians**

Table 8. $(N,\boxplus)$

$\boxplus$	O^+	O^-	A^+	A^-	B^+	B^-	AB^+	AB^-
O^+	O^+ O^-	O^+ O^-	A^+ A^- O^+ O^-	A^+ A^- O^+ O^-	B^+ B^- O^+ O^-	B^+ B^- O^+ O^-	A^+ A^- B^+ B^-	A^+ A^- B^+ B^-
O^-	O^+ O^-	O^-	A^+ A^- O^+ O^-	A^- O^-	B^+ B^- O^+ O^-	B^- O^-	A^+ A^- B^+ B^-	A^- B^-
A^+	A^+ A^- O^+ O^-	A^+ A^- O^+ O^-	A^+ A^- O^+ O^-	A^+ A^- O^+ O^-	N	N	AB^+ AB^- A^+ A^- B^+ B^-	AB^+ AB^- A^+ A^- B^+ B^-
A^-	A^+ A^- O^+ O^-	A^- O^-	A^+ A^- O^+ O^-	A^- O^-	N	AB^- A^- B^- O^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^- A^- B^-
B^+	B^+ B^- O^+ O^-	B^+ B^- O^+ O^-	N	N	B^+ B^- O^+ O^-	B^+ B^- O^+ O^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^+ AB^- A^+ A^- B^+ B^-
B^-	B^+ B^- O^+ O^-	B^- O^-	N	AB^- A^- B^- O^-	B^+ B^- O^+ O^-	B^- O^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^- A^- B^-
AB^+	A^+ A^- O^+ O^-	A^+ A^- O^+ O^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^+ AB^- A^+ A^- B^+ B^-
AB^-	A^+ A^- O^+ O^-	A^- B^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^- A^- B^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^- A^- B^-	AB^+ AB^- A^+ A^- B^+ B^-	AB^- A^- B^-

Table 9. $(X,\boxplus)$

$\boxplus$	M	N	MN
M	M	M, MN	MN
N	M, MN	X	N, MN
MN	MN	N, MN	N

Table 10. $(P,\boxplus)$

$\boxplus$	M^+	M^-	N^+	N^-	MN^+	MN^-
M^+	M^+ M^-	M^+ M^-	MN^+ MN^-	MN^+ MN^-	M^+ M^- MN^+ MN^-	M^+ M^- MN^+ MN^-
M^-	M^+ M^-	M^-	MN^+ MN^-	MN^-	M^+ M^- MN^+ MN^-	M^- MN^-
N^+	MN^+ MN^-	MN^+ MN^-	N^+ N^-	N^+ N^-	N^+ N^- MN^+ MN^-	N^+ N^- MN^+ MN^-
N^-	MN^+ MN^-	MN^-	N^+ N^-	N^-	N^+ N^- MN^+ MN^-	N^- MN^-
MN^+	M^+ M^- MN^+ MN^-	M^+ M^- MN^+ MN^-	N^+ N^- MN^+ MN^-	N^+ N^- MN^+ MN^-	P	P
MN^-	M^+ M^- MN^+ MN^-	M^- MN^-	N^+ N^- MN^+ MN^-	N^- MN^-	P	M^- N^- MN^-

Furthermore, let $Y = \{Jk^{(a+b+)}, Jk^{(a+b-)}, Jk^{(a-b+)}, JK^{(a-b-)}\}$. The result of $(Y,\boxplus)$ is in Table 11. (Note : Here, $Jk^{(a+b+)} \boxplus Jk^{(a+b+)} = \{Jk^{(a+a+)}, Jk^{(a+b+)}\}$. We ignore $Jk^{(a+a+)}$ because it is not in the phenotypes. Here, $Jk^{(a+b+)} \boxplus Jk^{(a+b+)} = Jk^{(a+b+)}$).

Table 11. $(Y,\boxplus)$

$\boxplus$	$Jk^{(a+b+)}$	$Jk^{(a+b-)}$	$Jk^{(a-b+)}$	$Jk^{(a-b-)}$
$Jk^{(a+b+)}$	$Jk^{(a+b+)}$	$Jk^{(a+b+)}$ $Jk^{(a+b-)}$	$Jk^{(a+b+)}$ $Jk^{(a-b+)}$	$Jk^{(a+b-)}$ $Jk^{(a-b+)}$
$Jk^{(a+b-)}$	$Jk^{(a+b+)}$ $Jk^{(a+b-)}$	$Jk^{(a+b-)}$	$Jk^{(a+b+)}$ $Jk^{(a-b-)}$	$Jk^{(a+b-)}$ $Jk^{(a-b-)}$
$Jk^{(a-b+)}$	$Jk^{(a+b+)}$ $Jk^{(a-b+)}$	$Jk^{(a+b+)}$ $Jk^{(a-b-)}$	$Jk^{(a-b+)}$	$Jk^{(a-b-)}$ $Jk^{(a-b+)}$
$JK^{(a-b-)}$	$Jk^{(a+b-)}$ $Jk^{(a-b+)}$	$Jk^{(a+b-)}$ $Jk^{(a-b-)}$	$Jk^{(a-b-)}$ $Jk^{(a-b+)}$	$Jk^{(a-b-)}$

Theorem 3.16 $(Y,\boxplus)$ is a NeutroSemihypergroup.
Proof. It is clear that $(Y,\boxplus)$ is not an AntiHyperstructures. Next, $Jk^{(a+b+)} \boxplus \left(Jk^{(a+b+)} \boxplus Jk^{(a+b+)}\right) = \left(Jk^{(a+b+)} \boxplus Jk^{(a+b+)}\right) \boxplus Jk^{(a+b+)}$ and $Jk^{(a+b-)} \boxplus \left(Jk^{(a+b-)} \boxplus Jk^{(a-b+)}\right) = \left\{Jk^{(a+b+)}, Jk^{(a+b-)}, Jk^{(a-b-)}\right\} \neq \left\{Jk^{(a+b+)}, Jk^{(a-b-)}\right\} = \left(Jk^{(a+b-)} \boxplus Jk^{(a+b-)}\right) \boxplus Jk^{(a-b+)}$.
Thus, $(Y,\boxplus)$ is a NeutroSemihypergroup.

Remark 3.17 $(Y,\boxplus)$ is not a NeutroHypergroup since $(Y,\boxplus)$ doesn't satisfy the NeutroReproduction Axiom.

Theorem 3.18 Let $Y_1 = \{Jk^{(a+b+)}, Jk^{(a+b-)}, Jk^{(a-b+)}\}$. Then, $(Y_1,\boxplus)$ is a NeutroHypergroup
Proof. The proof is similar to that of Theorem 3.10.

Remark 3.19 It is clear that $(Y_2 = \{Jk^{(a+b+)}, Jk^{(a+b-)}, Jk^{(a-b-)}\}, \boxplus)$ and $(Y_3 = \{Jk^{(a+b+)}, Jk^{(a+b-)}, Jk^{(a-b-)}\}, \boxplus)$ are NeutroHypergroups.

4. Conclusions

Based on the previous explanations, we have investigated NeutroHyperstructures related to color inheritance in Mirabilis Jalapa and coat color, as well as the inheritance of blood types ABO, ABO with rhesus, MN, MN with rhesus, and the Kidd system. The types of NeutroHyperstructures obtained include NeutroHypergroup for Mirabilis Jalapa, coat color, ABO blood groups, ABO with rhesus, MN blood groups, and MN with rhesus and NeutroSemihypergroup for Kidd Blood Groups. For future research, we can investigate the types of NeutroHyperstructures in other fields.

5. Future Work

For future research, we can investigate the types of NeutroHyperstructures in other fields.

Funding: This research received no external funding

Conflicts of Interest: The authors declare no conflict of interest

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Received: July 3, 2023. Accepted: Nov 19, 2023