

Transcriptional changes associated with imprinting in chick intermediate medial mesopallium: results and comparison of two different transcriptomic technologies

Kristine Eliosidze

Master's thesis submitted to the faculty of Natural Sciences and Medicine of Ilia State University of Georgia according to the requirements for the Degree of Master of Science in Molecular Biosciences

Program: Molecular Biosciences

Supervisor: Vincenzo Lagani, PhD

Ilia State University

Tbilisi, 2022

Table of Contents

Table of Contents	i
Abbreviation	ii
Abstract	1
Introduction	1
The importance of memory formation process	1
Role of the imprinting in the memory and learning processes	1
Transcriptomics and RNA-Seq tools for imprinting	2
Two transcriptomic technologies: bulk RNA-Seq and scRNA-seq	3
Literature review	3
History of the knowledge about memory	3
Pioneer researchers and the first steps to investigate ‘Memory’	4
Today’s knowledge about memory	5
Imprinting	6
Techniques for revealing transcriptomic changes	7
The comparison of two different transcriptomic technologies	8
When the data is ready to analyze	9
Materials and methods	10
The source of data provided by the Institute of Chemical Biology at Ilia State University	9
Bioinformatic tools for transcriptomic data	11

Results -----	12
Conclusion and discussion -----	18
Acknowledgments -----	18
References -----	19
Attachments -----	21

Abbreviations

IMM – Intermediate and medial mesopallium

IMHV – Intermediate and medial hyperstriatum ventral

RNA – Ribonucleic acid

RNA-Seq – Ribonucleic acid sequencing

NGS – Next-generation sequencing

scRNA-seq – Single-cell RNA sequencing

AMPA – alpha-amino-3-hydroxy-methyl-4-isoxazole-propionic acid

NMDA - N-methyl-D-aspartate

VW - Visual Wulst

HDCo - Hyperpallium densocellulare cells

GABA – γ -Aminobutyric acid

DNA – Deoxyribonucleic acid

dNTPs - Deoxyribonucleotide triphosphates

LTP – Long-term potentiation

HGP – Human genome project

UMI - unique molecular identifier

Abstract

This research aims to identify transcriptomics changes associated with memory formation and with imprinting. As the intermediate and medial mesopallium (IMM) plays a vital role for visual imprinting in chicks, we analyze trained and untrained chick IMM samples profiled using two different transcriptomic technologies (Bulk RNA sequencing and Single-nuclei RNA sequencing). Results show that the two technologies provide somewhat discordant results, indicating that caution should be exercised when choosing between the two technologies.

Introduction

The importance of memory formation process

Memory is a strong mental function with numerous ramifications for life; it's the origin of storing and retrieving information. Human memory is divided into three categories: sensory memory, short-term memory, and long-term memory (Camina and Güell 2017). The whole spectrum of this complicated memory formation process and other neuroanatomical, neurobiological, neurophysiological, and psychological mechanisms are still unknown. It's still challenging for psychologists and neuroscientists to explain it (Camina and Güell 2017). In recent years, many theories evolved regarding how the brain organizes all of those complicated processes, learning and memory. Those theories are the key points for a better understanding of the importance of the memory formation process and related neurological disorders like schizophrenia, depression and other anxiety disorders (Nadel and Hardt 2011).

Role of the imprinting in the memory and learning processes

When we talk about memory and learning, it's crucial to reveal the importance of the imprinting process. Visual imprinting is a learning process in which young animals develop a social preference for visual stimuli after being exposed to that object or after training. Since antiquity, this process has been known, its behavioral traits have been thoroughly researched, and the most well-known organisms are galliform birds: chickens, ducks, and quail (McCabe 2019).

Early findings to exemplify the importance of the imprinting process for a better understanding of memory and learning have been presented by Horn and McCabe in 1986. They showed the results of several experiments in which intermediate and medial