REFORMULATION OF THE ACEH HIJRI CALENDAR ALGORITHM

THESIS

Submitted to Part Partially of the Requirements
To Earn a Master Degree
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Written By:
Wali Cosara
Student ID: 2102048022

**MAGISTER PROGRAM OF SHARIA AND LAW
POSTGRADUATE
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STATEMENT OF THESIS AUTHENTICITY

The undersigned below:

Full Name : **Wali Cosara**
Student ID Number : 2102048022
Research Title : **Reformulation of The Aceh Hijri Calendar Algorithm**
Study Program : Falak Science
Faculty : Sharia and Law

Declares that the thesis entitled:

REFORMULATION OF THE ACEH HIJRI CALENDAR ALGORITHM

As a whole is the result of my research/work of the author, except for certain parts that the source refers to.

Semarang, March 24, 2023
Declaration Maker

Wali Cosara
Student ID: 2102048022

KEMENTERIAN AGAMA REPUBLIK INDONESIA
UNIVERSITAS ISLAM NEGERI WALISONGO
FAKULTAS SYARI'AH DAN HUKUM
Jalan Prof. Dr. H. Hamka Semarang 50185 Telepon (024)7601291, Faxsimili
(024)7624691, Website : http://fs.walisongo.ac.id

PENGESAHAN PERBAIKAN
OLEH MAJELIS PENGUJI UJIAN TESIS

Yang bertanda tangan di bawah ini menyatakan bahwa tesis mahasiswa:

Nama   : Wali Cosara
NIM   : 2102048022
Judul   : Reformulation of the Aceh Hijri Calendar Algorithm

Telah diujikan pada tanggal 14 April 2023 dan dinyatakan **LULUS** oleh majelis penguji:

NAMA	TANGGAL	TANDA TANGAN
Dr. Tolkhah, M.A. ketua Majelis	17/4/2023	
Dr. Fakhruddin Aziz, Lc, M.S.I Sekretaris	17/4/2023	
Prof. Dr. Muslich Shabir, MA. Penguji 1	17/4/2023	
Dr. Amir Tajrid, M.Ag. Penguji 2	17/4/2023	

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The Dean of the Faculty of Sharia and Law
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At Semarang

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Name   : Wali Cosara
Student ID Number   : 2102048022
Study Program   : Magister of Falak Science
Title   : Reformulation of The Aceh Hijri Calendar Algorithm

We consider of this thesis already can be submitted to the sharia and law faculties of State Islamic Universityof Walisongo Semarang to be defended in the thesis examination session.

Wassalamu'alaikum wr.wb.

Academic Supervisior I

Dr. Tolkah, M.A.
Employee ID: 196905071996031005

OFFICIAL MEMO

Semarang, March 24, 2023

To
The Dean of the Faculty of Sharia and Law
State Islamic Universityof Walisongo Semarang
At Semarang

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defended in the thesis examination session.

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Academic Supervisior II

Dr. Ahmad Syifaul Anam, S.Hi, M.H.
Employee ID: 198001202003121001

ABSTRACT

The way to calculate the beginning of the Hijri month for the people of Aceh is different from the Hijri calendar in every other area. Especially the people of Aceh do not apply corrections in their calculations, thus making this calendar very inconsistent with the Hijri calendar. For this reason, a correction formula is needed that adapts the Aceh Hijri calendar to the Neo Mabims Hijri calendar. The aims of this thesis are 1) Understand the original algorithm of the Aceh Hijri calendar. 2) Understand the additional formula to the formula for the beginning of the month of the Aceh Hijri Calendar so that it conforms to the Hijri calendar according to the criteria from Neo-Mabims. 3) Find out the level of accuracy of the new formula for the Aceh Hijri calendar compared to the Hijri calendar using the criteria from Neo-Mabims.

The formulation of the problems of this thesis is: 1) what is the original algorithm for calculating the Aceh Hijri calendar?, 2) what is the additional formula for linking the Aceh Hijri calendar with the Hijri calendar using Neo-Mabims criteria?, and 3) what is the level of accuracy of the new formula in connecting the Aceh Hijri calendar with the Hijri calendar using the Neo-Mabims criteria?

This thesis will use descriptive, analytical, and comparative methods, to write down the formula or algorithm to be achieved in this research and compare the Aceh Hijriah Calendar and the Neo Mabims Hijriah Calendar. This type of research is library research. Methods of description and analysis in answering research questions and methods of comparison in determining the level of accuracy of the Aceh Hijri calendar

The results of this thesis are: First, the Acehnese calendar has an age of 354 days and 9 hours in one year, this causes the year letter to become أهجزدبود and the month will leave one or two days, this causes the month letter to become زبجه وابدا زاج. Second, there is an age difference between Aceh's Hijri calendar and the Hijri calendar of 11 minutes in one year. Every 108 years, the Aceh calendar must be reduced by 1 day so that it can adjust to the Hijri calendar. Third, based on the results of a comparison from 1 to 1500 Hijriah, the accuracy of calculating the Aceh calendar using a repetition of 108 years is similar to the Neo Mabims Hijri calendar by as much as 41 percent or as many as 7415 months.

Keywords: Beginning of the month, Aceh Calendar, Aceh Almanac

ABSTRAK

Cara menghitung awal bulan Hijriah bagi masyarakat Aceh berbeda dengan penanggalan Hijriah pada setiap daerah lainnya. Terutama masyarakat Aceh tidak menerapkan koreksi dalam perhitungannya, sehingga membuat kalender ini sangat tidak sesuai dengan kalender hijriah. untuk itu perlunya rumus koreksi yang menyesuaikan antara kalender Hijriah Aceh dengan kalender Hijriah Neo Mabims. Tujuan dari tesis ini adalah 1) Memahami algoritma asli dari kalender Aceh Hijriah. 2) Memahami rumus tambahan terhadap rumus awal bulan Kalender Aceh Hijriah sehingga sesuai dengan kalender Hijriah menurut kriteria dari Neo-Mabims. 3) mengetahui tingkat akurasi formula baru dari kander Aceh Hijriah dengan kalender Hijriah menggunakan kriteria dari Neo-Mabims.

Rumusan masalah dari tesis ini adalah 1) bagaimana Algoritma Asli dari perhitungan kalender Hijriah Aceh?, 2) apa rumus tambahan untuk menghubungkan kalender Hijriah Aceh dengan kalender Hijriah menggunakan kriteria Neo-Mabims?, 3) bagaimana tingkat akurasi formula baru dalam menghubungkan kalender Hijriah Aceh dengan kalender Hijriah menggunakan kriteria Neo-Mabims?.

Tesis ini akan menggunakan metode deskriptif dan analitik dan perbandingan, yang menuliskan rumus atau algoritma yang ingin dicapai dalam penelitian ini dan membandingkan Kalender Hijriah Aceh dan Kalender Hijriah Neo Mabims. Jenis penelitian ini adalah penelitian kepustakaan. Metode deskripsi dan analisis dalam menjawab pertanyaan penelitian dan metode perbandingan dalam mengetahui tingkat ketepatan penanggalan Hijriah Aceh.

Adapun hasil dari penelitian tesis ini adalah: Pertama, kalender Aceh memiliki umur 354 hari 9 jam dalam satu tahun, hal ini menyebabkan huruf tahun menjadi أهجزديود dan bulan akan menyisakan satu atau dua hari, hal ini menyebabkan huruf bulan menjadi زبجه وابدا زاج Kedua, ada perbedaan umur antara Aceh Kalender Hijriah dan penanggalan Hijriah sebanyak 11 menit dalam satu tahun. Setiap 108 tahun, penanggalan Aceh harus dikurangi 1 hari agar dapat menyesuaikan dengan penanggalan Hijriah. Ketiga, Berdasarkan hasil perbandingan dari 1 sampai 1500 Hijriah, ketepatan perhitungan penanggalan Aceh dengan menggunakan pengulangan 108 tahun memiliki kemiripan dengan penanggalan Neo Mabims Hijriah sebanyak 41 persen atau sebanyak 7415 bulan.

Kata kunci: Awal bulan, Kalender Aceh, Almanak Aceh

ARABIC-LATIN TRANSLITERATION GUIDE
Joint decisions of the Minister of Religion and the Minister of Education and Culture
Number: 158/1987 and Number 0543b/U/1987

1. Consonant

No.	Arabic	Latin	No.	Arabic	Latin
1	ا	not denoted	16	ط	ṭ
2	ب	B	17	ظ	ẓ
3	ت	T	18	ع	'
4	ث	ṡ	19	غ	g
5	ج	J	20	ف	f
6	ح	ḥ	21	ق	q
7	خ	Kh	22	ك	k
8	د	D	23	ل	l
9	ذ	Ż	24	م	m
10	ر	R	25	ن	n
11	ز	Z	26	و	w
12	س	S	27	ه	h
13	ش	Sy	28	ء	'
14	ص	ṣ	29	ي	y
15	ض	ḍ			

2. Short Vokal		
◌َ... = a	كَتَبَ	Kataba
◌ِ... = i	سُئِلَ	Su'ila
◌ُ... = u	يَذْهَبُ	yaŻhabu

3. Long Vokal		
آ = ā	قال	qāla
اِي = ī	قِيْلَ	qīla
أو = ū	يَقُوْلُ	yaqūlu

4. Diphthong		
اي = ai	كيفَ	Kaifa
أَو = au	حَولَ	Haula

Note:
The word [al-] in syamsiyah or qomariyah is written [al-] consistently so that is in harmony with the Arabic text
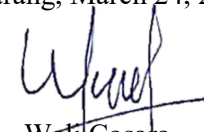
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Semarang, March 24, 2023

Wali Cosara
Student ID 2102048022

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PICTURE

CHAPTER I

INTRODUCTION

A. Background

Aceh, as one of the provinces in Indonesia, has cultural expressions as well as cultural heritage and community identity.[1] There is an Acehnese *hadih maja* (wise words) portraying the need to preserve cultural values: "*Matee aneuk meupat jeurat, gadoh adat pat Tamita*." It means that when a child dies, one can find the grave, but if tradition and culture are lost, one does not know where to seek.[2]

The phrase is not just a nice metaphor without meaning. It is a statement full of meaning and philosophical values that should be considered by the entire community in attempts to maintain and preserve the culture of Aceh. The transformation of cultural values is a form of conservation effort so as to survive and thrive in the future. The process of cultural transformation does not change the local culture entirely. The roots of the culture are maintained, added to, and adapted to the changing times. Steps are taken to make sure that local cultural

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[1] Yulia et al., "The Preservation of Traditional Cultural Expression in Aceh and Malaysia," *International Journal of Science and Research* Vol 8, no. 11 (2019): 484.

[2] Puspa Hildayani, Tati Narawati, and Trianti Nugraheni, "Study of Instilling the Social Values of Hadih Maja in Tarek Pukat Dance," *Advances in Social Science, Education and Humanities Research* Vol 255 (2018): 284.

identity continues to survive while at the same time being able to answer the challenges of an increasingly globalized modernity.[3]

The fate of culture is gradually fading; due to the lack of public concern for preserving this culture, traditional culture seems only to be a legacy to be remembered and not to be preserved. As if culture were not under the times. Moreover, make the culture passed down just as a story that the predecessors had created a culture. However, the existing culture must be maintained and preserved as an asset for future generations.[4]

One of the missing Acehnese cultures is the calendar used by the Acehnese during the royal period. The calendar used at that time served as a schedule for administration and daily worship activities. In this thesis, this calendar is hereinafter referred to as the Aceh Hijri Calendar. There are several facts to this thesis, including the fact that the people of Aceh actually have a calendar system that was adopted from the Hijri calendar system:

a) Islam and astronomy (Falak science) cannot be separated. This is because astronomy is needed to determine the time and direction of daily Muslim activity. So it can be concluded that the early development of Islam and astronomy in the

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[3] Mujiburrahman and Saiful Muluk, "School Culture Transformation Post Islamic Law Implementation in Aceh," *Research Article: American Scientific Publishers* Vol 23, no. 3 (2017): 2.

[4] Andi Fadinul, "The Loss of Nandong Culture in Sambay Village, West Aceh: A Sociology Perspective," *Arkus* Vol 6, no. 2 (2020): 109.

archipelago was based on the development of the Islamic empire in the archipelago with the establishment of the Samudera Pasai Kingdom. This shows that Aceh was the first region to develop astronomy in the archipelago. The Samudera Pasai Sultanate was founded by Sultan Malik As-Saleh. This is evidenced by the discovery of the remains of a tomb belonging to Sultan Malik As-Saleh, which is located in village Beuringen village, Samudera district, Aceh province.[5] written:

هـذا القـبر المرحوم المغفور التقي الناصـح الحسـيب النسـيب الكـريم العبيـد الفـاتح الملقب سلطان مالك الصـالح الـذي إنتقل مـن شـهر رمضـان سـنة ست وتسعـين وست مائة من إنتقال النبوية سقى الله سره وجعل الجنة مثواه لاإله إلاالله مُحَّمد رسول الله.

This is the grave of a person who is blessed and forgiven; a person who is pious (fear of Allah's wrath and punishment) and is a giver of advice; a person who comes from an honorable family and from a well-known lineage; a person who is generous (forbearing); a person who is strong in worship ('abid) is more liberator; the one who was called [with] Sultan [Al-]Mâlik Ash-Salih, who moved [to Rahmatullah] since the month of Ramadan in 696 from the migration of the Prophet [saw]; May Allah shower [his mercy] upon his grave and make heaven, where he lives, a place of honor. La ilaha illa-Llah Muhammadun Rasulullah (There is no god but Allah; Muhammad is the messenger of Allah.).[6]

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[5] Rinaldi Mirsa et al., "Space Pattern of Samudera Pasai Sultanate," *International Journal of Engineering, Science & InformationTechnology (IJESTY)* Vol 1, no. 2 (2021): 94.

[6] Sekretariat Direktorat Jendral Kebudayaan, *Album Nisan Samudra Pasai* (Jakarta, 2012), 19.
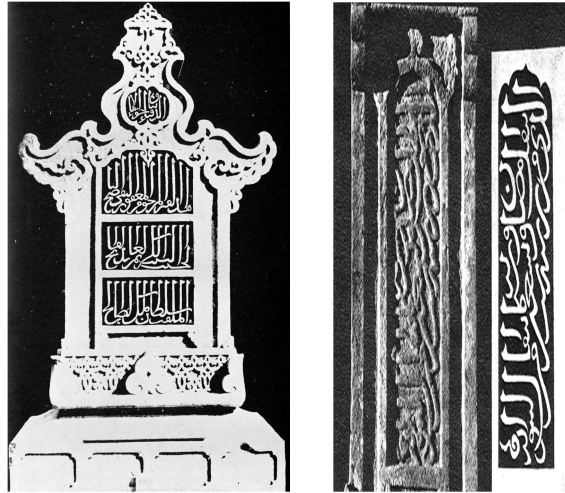
Picture 1.1 Headstone[7] and Side of headstone[8] of Sultan Malik
As-Saleh

Not only the tomb of the first sultan of the Samudra Pasai kingdom, but the tombs of other sultans also used the Hijiri calendar. Based on this, it can be proven that activities in the Samudera Pasai kingdom use the Hijri calendar.

b) There are several manuscripts written by scholars who are the leaders of the community about how to count the days at the beginning of each Hijri month. In this thesis, there are two

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[7] Elizabeth Lambourn, "Headstone of Sultān Al-Malik Al-Sālih," *ResearchGate*, 2008, https://www.researchgate.net/figure/Headstone-of-Sultan-al-Malik-al-Salih-d-Ramadan-696-23-June-22-July-1297-Samudra_fig2_233699953.

[8] Elizabeth Lambourn, "Side of the Headstone of Sultān Al-Malik Al-Sālih," *ResearchGate*, 2008, https://www.researchgate.net/figure/Side-of-the-headstone-of-Sultan-al-Malik-al-Salih-giving-his-date-of-death-in-Ramadan_fig3_233699953.

manuscripts that are the main reference sources for analyzing the Aceh Hijri Calendar algorithm. manuscript Risalah Asy-Shaykh 'Abd Ar-Rauf fi At-Taqwim, which is a manuscript about Sheikh Abdur Rauf Singkil (Syiah Kuala), explaining the method of determining the day at the beginning of the Hijri month[9] and the manuscript *Ilmu Falak* Teuku Imum Lhok Kaju, which contains a table of the first day of the Hijri month calendar.[10]

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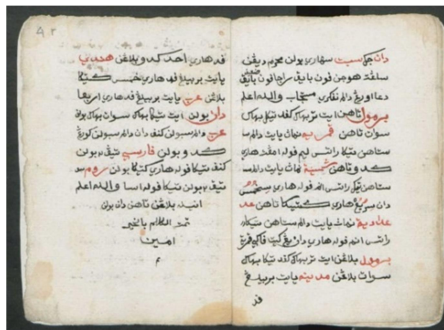
[9] Arwin Juli Rakhmadi Butar Butar, *Mengenal Karya-Karya Ilmu Falak Nusantara Transmisi, Anotasi, Dan Biografi* (Yogyakarta: CV. Arti Bumi Intaran, 2018).

[10] Pedir Museum, "Naskah Ilmu Falak Teuku Imum Lhok Kaju," 2019, https://pedirmuseum.blogspot.com/2019/06/naskah-ilmu-falak-teuku-imum-lhok-kaju.html.

Picture 1. 2 Three pages of Manuscript of *Risalah Asy-Syaikh 'Abd Ar-Rauf fi At-Taqwim*[11]

Picture 1. 3 Unlined table beginning day from Teuku Imum Lhok Kaju[12]

c) There are books written by present-day scholars, and one of the orientalists who researches Aceh is known as Abdul Ghafur or Christian Scouck Hurgronje. In this thesis, there are two books that are the main sources for analyzing the Aceh Hijri Calendar algorithm. a book with the title Tajul Muluk, written by Syeh Ismail Aceh, which explains the method of determining the day at the beginning of the Hijri month and the day table for each letter of the year and month

[11] Arwin Juli Rakhmadi Butar Butar, *Ilmu Falak Dalam Syaikh Abdur Rauf Singkil (Atas Kajian Naskah "Risalah Fi at-Taqwim")*, ed. Dewi Kusumaningsih and Nur Rochman Fatoni (Yogyakarta: Bildung, 2020).

[12] Pedir Museum, "Naskah Ilmu Falak Teuku Imum Lhok Kaju."

of Hijri[13] and the Acehnese book written by Christiaan Snouck Hurgronje, which explains the method of calculating the Hijri calendar used by the people of Aceh.[14]

In the book "*Orang Aceh: Budaya, Masyarakat dan Politik Kolonial*" written by Cristian Snouck Hurgronje explained that the community uses its own method of calculating the Hijri calendar.[15] This shows that the method of calculating the day at the beginning of each Hijri month for the people of Aceh is different from the Hijri calendar. Moreover, the Acehnese people don't apply corrections in their calculations, so that the Hijri calendar that uses contemporary calculations is more effective and accurate than the Hijri calendar system used by the people of Aceh. Actually the existence of the average calculation is not relevant to what is desired by the sharia,[16] this is because the calculation is not certain and accurate.

The Acehnese Calendar is a lunar calendar which is a source of reference for the Acehnese people in worship and carrying out their daily activities. The Aceh Hijri Calendar is similar like the Hijri Calendar and the Islamic Javanese calendar. The think that distinguishes the Acehnese calendar from other lunar calendars is the calculation

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[13] Syaikh Ismail Al-Asyi, *Tajul Mulk*, ed. Hasan Basuthi (Sanaqafurah-Jeddah: Al-Maktabah Haramain, n.d.), 28.

[14] C. Snouck Hurgronje, *Orang Aceh Budaya, Masyarakat, Dan Politik Kolonial*, ed. Endah Raharjo (Yogyakarta: Matabangsa, 1906).

[15] Ibid.

[16] Ahmad Izzuddin, "Hisab Rukyah Islam Kejawen," *Manahij: Jurnal Kajian Hukum Islam* Vol 9, no. 1 (2015): 125.

algorithm. The Aceh Hirjri calendar calculation method uses the *urfi* reckoning method which calculates the average phase of the moon.

The Acehnese calendar uses an eight-year cycle consisting of the letters أ, ه, ز, ج, د, ب, و and د.[17] There are two year letters of د, the د in the first year is called the first د, and the د in the second year is called the last د. So that the arrangement of the year letters is أ, ه, ز, ج, first د, ب, و, last د. Every 8 years, the Aceh Hirji Calendar will return to the first year.

The Acehnese calendar also uses letters in every 12 months (from Muharram to Dzulhijjah) consisting of letters د, ب, أ, و, ه, ج, ب, ز, ه, ز, أ and ج.[18] There are several months in the Aceh Hijri Calendar names that are different from the months in the Hijri Calendar. That is because the months on the Hijri calendar have been adopted and adapted to the activities and needs of the people of Aceh.

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[17] Wali Cosara, Akhmad Arif Junaidi, and Ahmad Fuad Al Ansori, "Hisab Awal Bulan Syiah Kuala (Menyunting Dari Naskah Risalah Asy-Syaikh 'Abd ArRauf Fi At-Taqwim)," *AL - AFAQ : Jurnal Ilmu Falak Dan Astronomi* Vol. 4, no. 1 (2022): 114.

[18] Butar, *Ilmu Falak Dalam Syaikh Abdur Rauf Singkil (Atas Kajian Naskah "Risalah Fi at-Taqwim")*, 43.

This is a comparison of the first days between the beginnings of the Hijri Calendar month (using the Global *Rukyat* criteria)[19] and the Aceh Hijri Calendar from 1441-1448 Hijri:

Hijri Year	Aceh Year Letter	Hijri Months	Aceh Month Letter	The first day of the month	
				Global *Rukyat*	Aceh Calendar
1441	و	*Muharram*	ز	Sunday	Monday
		Shafar	ب	Monday	Wednesday
		Rabiu Awal	ج	Tuesday	Thursday
		Rabiul Akhir	هـ	Thursday	Saturday
		Jumadil Awal	و	Saturday	Sunday
		Jumadil Akhir	أ	Sunday	Tuesday
		Rajab	ب	Tuesday	Wednesday
		Sya'ban	د	Thursday	Friday
		Ramadhan	هـ	Friday	Saturday
		Syawal	ز	Sunday	Monday
		Dzulqa'dah	أ	Tuesday	Tuesday
		Dzulhijjah	ج	Wednesday	Thursday
1442	د	*Muharram*	ز	Thursday	Saturday

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[19] Al Habib, "Pengubah Tanggal Masehi Dari/Ke Hijriyah," accessed January 27, 2023, https://www.al-habib.info/kalender-islam/pengubah-tanggal-lahir-kalender-hijriyah.htm.

Hijri Year	Aceh Year Letter	Hijri Months	Aceh Month Letter	The first day of the month	
				Global *Rukyat*	Aceh Calendar
	(الأخر)				
		Shafar	ب	Saturday	Monday
		Rabiu Awal	ج	Sunday	Tuesday
		Rabiul Akhir	هـ	Monday	Thursday
		Jumadil Awal	و	Wednesday	Friday
		Jumadil Akhir	أ	Thursday	Sunday
		Rajab	ب	Saturday	Monday
		Sya'ban	د	Monday	Wednesday
		Ramadhan	هـ	Tuesday	Thursday
		Syawal	ز	Thursday	Saturday
		Dzulqa'dah	أ	Saturday	Sunday
		Dzulhijjah	ج	Sunday	Tuesday
1443	أ	*Muharram*	ز	Tuesday	Wednesday
		Shafar	ب	Wednesday	Friday
		Rabiu Awal	ج	Friday	Saturday
		Rabiul Akhir	هـ	Saturday	Monday
		Jumadil Awal	و	Monday	Tuesday
		Jumadil Akhir	أ	Tuesday	Thursday

Hijri Year	Aceh Year Letter	Hijri Months	Aceh Month Letter	The first day of the month	
				Global *Rukyat*	Aceh Calendar
		Rajab	ب	Wednesday	Friday
		Sya'ban	د	Friday	Sunday
		Ramadhan	هـ	Sunday	Monday
		Syawal	ز	Monday	Wednesday
		Dzulqa'dah	أ	Wednesday	Thursday
		Dzulhijjah	ج	Thursday	Saturday
1444	هـ	*Muharram*	ز	Saturday	Sunday
		Shafar	ب	Monday	Tuesday
		Rabiu Awal	ج	Tuesday	Wednesday
		Rabiul Akhir	هـ	Thursday	Friday
		Jumadil Awal	و	Friday	Saturday
		Jumadil Akhir	أ	Sunday	Monday
		Rajab	ب	Monday	Tuesday
		Sya'ban	د	Tuesday	Thursday
		Ramadhan	هـ	Thursday	Friday
		Syawal	ز	Friday	Sunday
		Dzulqa'dah	أ	Sunday	Monday
		Dzulhijjah	ج	Monday	Wednesday
1445	ج	*Muharram*	ز	Wednesday	Friday

Hijri Year	Aceh Year Letter	Hijri Months	Aceh Month Letter	The first day of the month	
				Global *Rukyat*	Aceh Calendar
		Shafar	ب	Friday	Sunday
		Rabiu Awal	ج	Sunday	Monday
		Rabiul Akhir	هـ	Monday	Tuesday
		Jumadil Awal	و	Wednesday	Thursday
		Jumadil Akhir	أ	Thursday	Saturday
		Rajab	ب	Saturday	Sunday
		Sya'ban	د	Sunday	Tuesday
		Ramadhan	هـ	Tuesday	Wednesday
		Syawal	ز	Wednesday	Friday
		Dzulqa'dah	أ	Thursday	Saturday
		Dzulhijjah	ج	Saturday	Monday
1446	ز	*Muharram*	ز	Sunday	Tuesday
		Shafar	ب	Tuesday	Thursday
		Rabiu Awal	ج	Thursday	Friday
		Rabiul Akhir	هـ	Friday	Sunday
		Jumadil Awal	و	Sunday	Monday
		Jumadil Akhir	أ	Tuesday	Wednesday
		Rajab	ب	Wednesday	Thursday

Hijri Year	Aceh Year Letter	Hijri Months	Aceh Month Letter	The first day of the month	
				Global *Rukyat*	Aceh Calendar
		Sya'ban	د	Friday	Saturday
		Ramadhan	هـ	Saturday	Sunday
		Syawal	ز	Monday	Tuesday
		Dzulqa'dah	أ	Tuesday	Wednesday
		Dzulhijjah	ج	Wednesday	Friday
1447	د (الأول)	*Muharram*	ز	Thursday	Saturday
		Shafar	ب	Saturday	Monday
		Rabiu Awal	ج	Monday	Tuesday
		Rabiul Akhir	هـ	Tuesday	Thursday
		Jumadil Awal	و	Thursday	Friday
		Jumadil Akhir	أ	Saturday	Sunday
		Rajab	ب	Sunday	Monday
		Sya'ban	د	Tuesday	Wednesday
		Ramadhan	هـ	Thursday	Thursday
		Syawal	ز	Friday	Saturday
		Dzulqa'dah	أ	Saturday	Sunday
		Dzulhijjah	ج	Monday	Tuesday
1448	ب	*Muharram*	ز	Tuesday	Thursday

Hijri Year	Aceh Year Letter	Hijri Months	Aceh Month Letter	The first day of the month	
				Global *Rukyat*	Aceh Calendar
		Shafar	ب	Thursday	Saturday
		Rabiu Awal	ج	Friday	Sunday
		Rabiul Akhir	هـ	Saturday	Tuesday
		Jumadil Awal	و	Monday	Wednesday
		Jumadil Akhir	أ	Wednesday	Friday
		Rajab	ب	Thursday	Saturday
		Sya'ban	د	Saturday	Monday
		Ramadhan	هـ	Monday	Tuesday
		Syawal	ز	Wednesday	Thursday
		Dzulqa'dah	أ	Thursday	Friday
		Dzulhijjah	ج	Friday	Sunday

Table 1. 1 Comparison of the day at the beginning month of the Hijri Calendar and Aceh Hijri Calendar

From that table, it can be concluded that there are many different days at the beginning of the Hijri month, thus making the Aceh Hijri Calendar incompatible with the Hijri Calendar. This is because the Aceh Hirji Calendar still uses the average calculation method (average calculation) and the Aceh Hirji Calendar doesn't have an additional

formula (correction), so it will make the Aceh Hirji Calendar match with the Hirji Calendar.

This significant difference has led many Acehnese people to abandon the Aceh Hijri Calendar system and use the Hijri Calendar system in matters of worship and daily activities. This is very reasonable because the Aceh Hijri Calendar and the Hijri Calendar are both based on the phases of the moon (a lunar calendar system), which should make no difference between the Aceh Hijri Calendar and the Hijri Calendar.

Therefore, this thesis conducts research on the algorithm of the Aceh Hijri Calendar system originating from manuscripts and books so that the Aceh Hijri Calendar is in accordance with the Hijri Calendar and can be used by the community in determining the time of worship and carrying out daily activities as in ancient times. This research can restore Acehnese culture (the Aceh Hijri Calendar system), which has been neglected at the moment. According to the background, this thesis is entitled **"Reformulation of the Aceh Hijri Calendar Algorithm"**.

B. Problem Statement

Based on that background, this thesis gets three main scientific problems:

1. How does the original algorithm of the Aceh Hijri Calendar system determine the day at the beginning of the Aceh Hijri Calendar month?

2. What is the additional formula for determining the day at the beginning of the Aceh Hijri Calendar month?

3. How accurate is the Aceh Hijri Calendar for determining the day at the beginning of the Aceh Hijri Calendar month?

C. Purpose and Research Benefits

This research was conducted with the aim of examining the Aceh Hijri Calendar system, which is the same as the Hijri Calendar. This Aceh Hijri Calendar can be reused in worship and carrying out daily activities. The main objectives of this research are:

1. Reveals the origin algorithm formula for the Aceh Hijri Calendar system in determining the day at the beginning of the Aceh Hijri Calendar month.

2. Reveals the addition of the formula to make the Aceh Hijri Calendar connected with the Hijri Calendar.

3. Knowing the level of accuracy of the Aceh Hijri Calendar for determining the day at the beginning of the Aceh Hijri Calendar month.

While the benefits of this thesis are:

1. Theoretically, to get a comprehensive understanding of the Hijri calendar system used by the Acehnese people in terms of history, methods, origins of formulas, and additional formulas (corrections), Understanding and studies so far are still limited to theories and methods of determining the beginning of the Hijri month, so an additional formula is needed so that the

method of determining the beginning of the Hijri month used by the people of Aceh can be valid for all time.

2. Practically, this research is expected to be useful in increasing scientific treasures, especially in discussing the calendar system and the beginning of the lunar month and maintaining the culture of the Aceh Hijri calendar system. With this research, the Aceh Hijri Calendar system created by great scholars during the Aceh kingdom can be reused and can be valid for all time.

D. Literature Review

So far, the author has not found a single reference that discusses the origin of the formula and corrections to the calculation of the beginning of the Hijri month used by the Acehnese people in the past. However, there are many studies examining the Hijri calendar system from various perspectives.

In the undergrad thesis "*Algoritma Awal Bulan Qomariyah dalam Naskah Risalah Asy-Syaikh 'Abd Ar-Rauf fi At-Taqwim*," written by Wali Cosara, he explains the steps to determine the beginning of the lunar month according to *Risalah Asy-Syaikh 'Abd Ar-Rauf fi At-Taqwim*, which is to understand the number of the Hijri year that you want to calculate, and then Divide the number of the Hijri year by eight, and add up the remainder of the division with all the letters so that you get the year value. Next, understand the letter of the month you want to search for and add up the letters of the month and the letters of the year. If the result of the division is more than seven, then the result is reduced

by seven. The result of adding the letters of the month and the letter of the year is the beginning of the lunar month.[20] Actually, this thesis is a research development of undergraduate thesis research, where in undergraduate research there is no correction formula that can adjust to the Hijri calendar. and the algorithm for undergrads must be developed so that it can be used in determining the algorithm for calculating the start of the day at the beginning of the Aceh Hijri Calendar month.

In the journal "Al-Afaq" written by Wali Cosara, Ahmad Arif Jurnaidi and Ahmad Fuad Al Ansori with the tittle "Hisab Awal Bulan Syiah Kuala (menyunting dari naskah *Risalah Asy-Syaikh 'Abd Ar-Rauf fi Taqwim*)" tell us about the method of the beginning of the Hijri month according to Syiah Kuala in the manuscript of *Risalah Asy-Syaikh 'Abd ar-Rauf fi at-Taqwim* uses the average counting method which is the calculation of the beginning of the lunar month based on the average age of the month, namely odd months of 30 days and even months of 29 days except in leap years for the 12th month (Dzulhijjah) of 30 days.[21] This journal only focuses on explaining the method of calculating the beginning of the Hijri month in the manuscript *Risalah Asy-Syaikh' Abd Ar-Rauf fi Taqwim*. This thesis uses the manuscript of *Risalah Asy-Syaikh 'Abd Ar-Rauf fi Taqwim* too as one of the primary data sources,

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[20] Wali Cosara, "Algoritma Awal Bulan Qamariyah Dalam Naskah Risalah Asy-Syaikh 'Abd Ar-Auf Fi At-Taqwim" (UIN Walisongo Semarang, 2021), 86.
[21] Cosara, Junaidi, and Ansori, "Hisab Awal Bulan Syiah Kuala (Menyunting Dari Naskah Risalah Asy-Syaikh 'Abd ArRauf Fi At-Taqwim)," 126.

but this thesis is different from this journal. The difference is that in this thesis there are additional formulas (a correction formula).

The article "*Aceh Local Wisdom in the Method of Determining the Hijri Calendar*" by Hasna Tuddar Putri and Ibnu Qodir in the journal "Al-Hilal: Journal of Islamic Astronomy" explains that the method of determining the Hijri calendar varies from one region to another. However, they are still related to each other on the basis of the formula used. The method of determining the Hijri calendar in Aceh tends to adopt a formula from Arabic that is adapted to local wisdom in Aceh. There are three methods for determining the Hijri calendar in Aceh, namely, the method of determining leap and common years using a simple algorithm. Secondly, the thirty-year cycle method, method whosebasic formula is simple arithmetic, namely multiplication, addition, and subtraction, Third, the eight-year cycle, which is a simplification of the thirty-year cycle described in Arabic letters, namely اهجزدبود. This cycle is a manifestation of an Acehnese local wisdom.[22] This journal just tells us about the formula from the book of Tajul Muluk. In this journal, there is no discussion regarding how the formula originated or adding formulas (corrections) so that they can adjust to the actual lunar calendar that the author will develop as a result of this research.

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[22] Hasna Tuddar Putri and Ibnu Qadir, "Aceh Local Wisdom In The Method of Determining The Hijri Calendar," *Al-Hilal: Journal of Islamic Astronomy* Vol 4, no. 1 (2022).

In the journal "*Al-Hilal: Journal of Islamic Astronomy*" written by Faiz Faricah with the tittle "The Java Calendar and Its Relevance With The Islamic Calendar" Explain that in the 8 year sewindu cycle, there are 3 long, leap, / wuntu years, totaling 255 days. and four short years (basithah and wastu), totaling 254 days. Thus, one year is equal to (255 x 3) + (254 x 4) = 2,835 days. So that in one cycle of 30 hijri calendar years, there is an excess of 1/4 longer days on the Javanese calendar. As a result, in 4 x 30 years = 120 years, the Javanese calendar will be one day ahead of the Hijrah calendar. So the Javanese calendar was adjusted to the Hijriyah calendar within 120 years, which is called the Kurup.[23]

In the journal "*Syaksia: Jurnal Hukum Keluarga Islam*" written by Muhammad Zainal Mawahib with the tittle "*Implikasi Penggunaan Sisitem Perhitungan Aboge dalam Penetapan Awal Bulan Hijriah*" Explain that in terms of the Aboge calendar system, the main benchmark is the year Alif, which always falls on Wednesday. The year provisions in the Aboge calendar have a cycle of 8 years (1 windu). Years in 1 Windu are named with the Jumali letters, which are based on the name of the day on 1 Suro in the year Alif. Therefore, there is a term for Early Jim Year and Late Jim sorted according to the rule بدزجاهجو,

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[23] Faiz Farichah, "The Java Calendar and Its Relevance With The Islamic Calendar," *Al-Hilal: Journal of Islamic Astronomy* Vol. 2 (2020): 238.

even though in the calculation of the first year it still starts with Alif year.[24]

Actually the Hijri calendar used by the people of Aceh is very similar to the Javanese Islamic calendar. The difference is that the hijri calendar used by the people of Aceh has a year letter that starts with the letter و and has the same year letter, namely the letter د (first د and last د). This distinguishes between the hijri calendar of the Aceh community and the Javanese Islamic calendar which begins with the letter أ and has the same year letter, namely the letter ج (first ج and last ج).

In the "*Journal Syari'ah*" written by Ismail with the tittle "*Sistem Kalender Paaa Masa Kerajaan Samudra Pasai*" explain when the Samudera Pasai Kingdom was still successful, the prevailing calendar system was the Hijri calendar which refers to the pure of *rukyatul hilal* (could be seen) and this calendar system applies to the provisions of worship and civil needs, remembering the importance of the date of death not only being an element of worship but also an element of administration to celebrate again such as *khanduri* every year (*khanduri haul*), this also illustrates that this calendar system is similar to the calendar system at the time of the Prophet SAW until the 17th year of

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[24] Muhammad Zainal Mawahib, "Implikasi Penggunaan Sistem Perhitungan Aboge Dalam Penetapan Awal Bulan Hijriah," *Syaksia: Jurnal Hukum Keluarga Islam* Vol 23, no. 2 (2022): 189.

the Hijri.[25] This journal only tells us about what calendar used in the Samudra Pasai Kingdom. This journal not tell us about how the calculation methods and algorithms in determining the beginning of the month to determine when to carry out of *rukyatul hilal*.

In the undergraduate thesis "*Analisis Koreksi Tuanku Abusani Terhadap Perhitungan Awal Bulan Kamariah Tarekat Syattariyah Ulakan Kota Padang*" written by Nurlina explained that "The way to determine the beginning of the lunar month used by Tuanku Abusani using *urfi* counting. This calculation uses the counting of jumali rule, both for the year and the months. This calculation includes a continuous cycle of years, which is every eight years. So that every eight years pass, the next year's cycle will return to the same as the previous eight years, and so on.[26] The method of calculating the beginning of the lunar month Tuanku Abusan is, first: determining the letter of the year, the method is to divide the desired year number by eight, then the remainder to determine the letter of the year, the remainder is calculated from the letter of end of د (*dal akhir*). Second: combine the value of the letter of the year with the letter of the month you want to search for. Third: the value of the sum is calculated from Thursday".[27]

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[25] Ismail, "Sistem Kalender Pada Masa Kerajaan Samudra Pasai," *Jurnal Syarah* Vol. 7, no. 1 (2018): 120.

[26] Nurlina, "Analisis Koreksi Tuanku Abusani Terhadap Perhitungan Awal Bulan Kamariah Tarekat Syattariyah Ulakan Kota Padang" (UIN Walisongo Semarang, 2017), 48.

[27] Ibid., 72.

Actually the Hijri calendar used by the people of Aceh is very similar like calculation of the beginning of the lunar month Tuanku Abusani at Tarekat Syattariyah in Padang city. The difference is that the hijri calendar used by the people of Aceh has a year letter that starts with the letter و and the value of the sum of the year letter and month letter is calculated from Wednesday. This distinguishes between the hijri calendar of the Acehnese and the Tuanku Abusani method which begins with the letter end of د (*dal akhir*) and the value of the sum of the year letter and month letter is calculated from Thursday.

In the journal "Al-Afaq" written by Muhammad Muzayyinul Wathoni with the tittle "Penentuan Awal Bulan Kalender Rowot Sasak Prespektif Fikih dan Astronomi" explain that Rowot Sasak calendar system consists of 12 months consisting of 30 days for months that are in odd order and 29 days for months that are in even order, except in the month of Zulhijjah which will be opened for 30 days if it is in a leap year. The Rowot Sasak calendar does not recognize the serial year, so it uses a *windon* pattern or an eight year pattern. Years that have remainders of 2, 5 and 7 will be leap years while the remainder of 1, 3, 4, 6 and 8 will be *basithah* years. The determination of the beginning of them onth in this calendar uses average counting, namely by calculating the average month, so that the 1st will consistently fall after the 30th or

29th of the previous month, i.e. 30 days for months that are in odd order and 29 days for months that are odd. is in even order.[28]

In the book "Al-Manak Hijriah di Aceh" written by Cut Zahrina explained that "Records of historical events based on al-manac hijri also contain celebrations that have become a tradition for the Acehnese people. so the name of the month in al-manac Hijri follows the name of the month of Aceh or is called *uroe buleuen Aceh*. Al-Manak Hijri the count starts at night which is named the lunar year. As for the names of the mention of *uroe buleuen Aceh* in the almanac Hijri are[29]:

No	Month Name in Arabic	Month Name in Aceh
1	*Muharram*	*Asan Usen*
2	*Safar*	*Sapha*
3	*Rabiul Awal*	*Maulot Phon*
4	*Rabiul Akhir*	*Maulot Teungoh*
5	*Jumadil Awal*	*Maulot Akhe*
6	*Jumadil Akhir*	*Khanduri Boh Kayee*
7	*Rajab*	*Khanduri Apam*
8	*Sya'ban*	*Khanduri Bu*
9	*Ramadhan*	*Puasaa*
10	*Syawal*	*Uroe Raya*
11	*Dzulqa'dah*	*Meuapet/Beurapet*
12	*Dzulhijjah*	*Haji*

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[28] Muhammad Muzayyinul Wathoni, "Penentuan Awal Bulan Kalender Rowot Sasak Perspektif Fikih Dan Astronomi," *AL – AFAQ : Jurnal Ilmu Falak Dan Astronomi* Vol. 3 (2021): 128–29.

[29] Cut Zahrina, *Al-Manak Hijriah Di Aceh*, ed. T.A. Sakti (Banda Aceh: Balai Pelestarian Nilai Budaya, 2013), 5.

Table 1. 2 Month Name in Arabic and in Aceh[30]

The Acehnese people for the names of days for one week, they have determined the names. While the number of days in a week is no different from the Gregorian calendar because both have seven days in a week. as for the names of the days specified are:

> *Aleuhad* is the name for the day Sunday
> *Seunayan* is the name for the day Monday
> *Seulasa* is the name for the day Tuesday
> *Rabu* is the name for the day Wednesday
> *Hameh* is the name for the day Thursday
> *Djeumeu'at* is the name for the day Friday
> *Satu* is the name for the day Saturday [31]

In this book, the author discusses the names of the months and the names of the days in the Aceh language and discusses the traditions that exist in Aceh, but the author does not discuss the Aceh Hijri Calendar system used by the Aceh people in the past.

E. Research Method

In supporting the implementation of the research to be carried out by the author, a relevant method is needed to discuss the object of the research. This research method includes the type of research, data sources, collection method, and analysis methods:

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[30] Ibid., 5–6.
[31] Ibid., 6.

1. Types of Research

This thesis used a qualitative method. According to Creswell, qualitative research is the research process designed according to a clear methodological tradition of research, whereby researchers build up a complex, holistic framework by analyzing narratives and observations, conducting the research work in the habitat.[32]

This type of research is library research and comparison, a type of research where data is not obtained from the field but from libraries or other places that store references, documents containing data that have been tested for validity.

2. Resources of Data

This study's data sources are divided into two categories: primary sources and secondary sources. Then the resources used are as follows:

a. Primary Sources

Primary data is the data that comes directly from the source of the data collected and is also directly related to the problems studied.[33] The primary data sources for this thesis are

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[32] J. W. Creswell, *Qualitative Inquiry and Research Design* (Thousand Oaks: Sage Publication, 1998); Iztok Devetak, Saša A. Glažar, and Janez Vogrinc, "The Role of Qualitative Research in Science Education," *Eurasia Journal of Mathematics, Science & Technology Education* Vol 6, no. 1 (2010): 78.

[33] Sugiyono, *Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, Kombinasi, R&D Dan Penelitian Pendidikan)* (Bandung: Alfabeta, 2019), 10.

the manuscript of "*Risalah Asy-Syaikh 'Abd Ar-Rauf As-Singkili*," which discusses the calculation of the beginning of the month of the Hijri calendar; the manuscript of "*Ilmu Falak Teuku Imum Lhok Kaju*;" the book of "*Tajul Muluk*," written by Syaikh Ismail Al-Asyi, which discusses the calculation of the beginning of the Hijri calendar; and the book "The Acehnese," written by Christian Snouck Hurgronje, which discusses the calculation of the Hijri calendar;

b. Secondary Sources

Secondary data is every type of data that is used to support the primary data in this study. This is everything related to this research, which discusses the calendar and algorithm. Then the results of this study were compared with the Hijri calendar according to MABIMS new criteria to determine the level of acidity against the Aceh Hijri calendar.

3. Method of Collecting Data

Data is informations regarding a matter related to the purpose of research. That mean not all of the information is research data.[34] To obtain the data needed of this thesis, the method that the author uses is the method of documentation. The documentation method is a data collection technique in the research that is addressed immediately to the research subject. These documents are regarding

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[34] Muhammad Idrus, *Metodologi Penelitian Ilmu Sosial: Pendekatan Kualitatif Dan Kuantitatif* (Yogyakarta: Erlangga, 2009), 61.

the matters or variables.[35] This method is used to obtain data from text related to algorithm of the Aceh Hijri Calendar and the Algorithm of Calendar.

4. Data Analysis Method

This thesis used a descriptive, analytical, and comparison method, which describes the formula or algorithm to be achieved in this research while comparing the Aceh Hijirah Calendar and the Mabims Hijri Calendar. The methods of describing and analyzing in answering the research question and the comparison method in finding out the level of accuracy of the Aceh Hijri calendar.[36] If the number of days according to the MABIMS's new criterion for the hijri calendar is compared to the difference of one day, then the calendar can be categorized as accurate.

F. Outline of Thesis

The outline of this research refers to the second type of qualitative method described in "*Panduan Penulisan Karya Tulis Ilmiah*" written by a postgraduate of the State Islamic University of Walisongo Semarang.[37] Consist of five chapters, in which each chapter consists of sub-discussion sections, those being:

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[35] Imam Gunawan, *Metode Penelitian Kualitatif Teori Dan Praktik* (Jakarta: PT Bumi Aksara, 2013), 162.

[36] Nyoman Kutha Ratna, *Metodologi Penelitian (Kajian Budaya & Ilmu Sosial Humaniora Pada Umumnya)* (Yogyakarta: Student Library, 2010), 336.

[37] *Panduan Penulisan Karya Tulis Ilmiah*, 3rd ed. (Semarang: Pascasarjana UIN Walisongo, 2018).

The first chapter is Introduction, in which the researcher discusses the main things in this research, which include: background, problem statement, purpose and research benefits, product specifications, and development assumptions.

The second chapter, The Hijri Calendar, the researcher discusses the basic theory of this research, which includes: understanding lunar calendars; the history of the Hijri calendar; and the method of determining the beginning of the month on the Hijri calendar.

The third chapter, The Aceh Hijri Calendar, the researcher discusses the Aceh Hijri Calendar, which is the object of study in this research, which includes an understanding of the Aceh Hijri Calendar and the method of determining the day of the Aceh Hijri Calendar.

The fourth chapter is the reformulation of the Aceh Hijri Calendar Algorithm. The researchers discuss the Aceh Hijri Calendar, which includes the original formula of the Aceh Hijri Calendar, the addition of the formula in determining the day at the beginning of the Aceh Hijri Calendar month, and the accuracy of the Aceh Hijri Calendar with the Hijri Calendar.

The fifth chapter is closing; the researchers conclude the research results of researchers and provide suggestions for readers on the results of research researchers.

CHAPTER II

HIJRI CALENDAR SYSTEM

A. Mean of the Hijri Calendar

The Hijri calendar is manifestation of astronomy involving several related disciplines like dynamical and optical physics, biophysics and of course mathematical and spherical astronomy.[38] It is, therefore, useful to make a brief survey of the role of astronomical science in Islamic civilization and then to contrast it with current state of astronomy in Muslim society.[39]

The Hijri Calendar is comprised of 12 lunar months, based on the cycles of the moon. Every new month starts with the sighting of the new month.[40] Each month in the Islamic calendar lasts from one first sighting of the crescent moon to the next.[41]

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[38] Mohammad Ilyas, *New Moon's Visibility and International Islamic Calendar for American Region 1407H-1421H* (Virginia: Organization of Ilamic Conference (OIC) Standing Commitee on Scientific & Technological Cooperation (COMSTECH), 1995), 4.

[39] Mohammad Ilyas, *Astronomy of Islamic Calendar* (Kuala Lumpur: A.S.Noordeen, 1997), 3.

[40] Fatima Syed and Naimat U. Khan, "Islamic Calendar Anomalies Evidence from Pakistan," *Business & Economic Review* Vol 9, no. 3 (2017): 105.

[41] Juan E. Campo, *Encyclopedia of Islam*, ed. J. Gordon Melton (New York: Library of Congress Cataloging, 2008), 124.

The Islamic calendar, comprised of 354 days (some time 353 or 355 days),[42] shifts with respect to the solar calendar, with each month in the former beginning 10 or 11 days earlier every year. Since the sighting of the moon sometimes varies with respect to longitude and latitude, the Islamic calendar may vary from one part of the world to another. Because the Islamic calendar shifts, solar calendars are often used in addition to Islamic calendars. In Iran, for instance, three calendars are in common use: the Persian solar, the Islamic, and the Gregorian. The hijri calendar are significant for Muslim to calculate precisely when during each day for perform the five obligatory prayers.[43]

B. History of the Hijri Calendar System

1. History of The Pre-Islamic Hijri Calendar

The first known calendar in human civilization is the lunar calendar. This is explained:

"The process of overseeing the passage of time and time can be said to be almost as much as human civilization. Although today we use the sun to determine the time, but in comparison, the use of the moon to determine the time was done first. The basic reason that influences the choice to use the moon as a determination in the calendar is because of the strength and superiority of the moon from an astronomical point of view compared to the sun. In addition, the use of the moon in the determination of time and time is easier, and

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[42] Helmer Aslaksen, "Heavenly Mathematics: The Mathematics of the Chinese, Indian, Islamic and Gregorian Calendars" (Nation University of Singapore, n.d.), 8.

[43] Campo, *Encyclopedia of Islam*, 124–25.

does not require any help to obtain the accuracy of its rotation system."[44]

In the past, before the arrival of Islam, Arab people were not familiar with the Hijri calendar or lunar calendar, at that time the calendar used by Arab people was the lunisolar calendar. The pre-Islamic Arabic calendar was like the Jewish calendar and started in autumn.[45]

The pre-Islamic lunisolar calendar had 12 months, each of which had 29 or 30 days, so that the number of days in a calendar year was 354 days. To adjust the number of days based on the moon's rotation around the earth (lunar monthgh) with the number of days in the solar year which totals about 11.53 days each year, an intercalary month was made in the Jewish calendar and the Arabic calendar before the time of Muhammad's apostolate. Reverberation is done every three years to keep the lunar calendar according to the

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[44] Muh. Nashirudin, *Kalender Hijriah Universal Kajian Atas Sistem Dan Prospeknya Di Indonesia*, ed. Abd. Ghoffar Mahfuz (Semarang: El-Wafa, 2013); Cosara, "Algoritma Awal Bulan Qamariyah Dalam Naskah Risalah Asy-Syaikh 'Abd Ar-Auf Fi At-Taqwim"; Mohammad Ilyas, *Kalender Islam Antarbangsa* (Kuala Lumpur: Dewan Bahasa dan Pustaka, 1999).

[45] Nashirudin, *Kalender Hijriah Universal Kajian Atas Sistem Dan Prospeknya Di Indonesia*, 60.

seasons.[46] As the 13th month which in the Qur'an is called the month of *an-nasi'*.[47]

2. Prohibiting *Nasi'*

Perceval hypothesized that the Hijri calendar initially adopted a lunar calendar, and with the time, when its observance became impractical, substituted it with a lunisolar calendar. When the month of harvest coincided with the pilgrimage, pilgrims found it particularly difficult to make their way to Makkah because of a lack of available supplies. The system of intercalation was therefore adopted in order to ensure the pilgrimage season would always fall in the month of harvest.[48] An intercalary month was eventually inserted between the months of *Dzulhijjah* and *Muharram* in a similar fashion to how the thirteen month of Adar II is inserted seven times in the Hebrew Calendar during a 19 year cycle.

Perceval suggested that the abolition of the intercalary month took place during the Prophet's Farewell Pilgrimage which subsequently led to the adoption of a purely lunar calendar. The

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[46] Thomas Djamaluddin, *Menggagas Fiqih Astronomi Telaah Hisab-Rukyat Dan Pencarian Solusi Perbedaan Hari Raya* (Bandung: Bandung Kaki Langit, 2005), 89.

[47] Tono Saksono, *Mengkompromikan Hisab & Rukyat* (Jakarta: Amythas Publicita, 2007), 61; Nashirudin, *Kalender Hijriah Universal Kajian Atas Sistem Dan Prospeknya Di Indonesia*, 61.

[48] Caussin De Perceval, "Memoire Sur Le Calendrier Arabe Avant I'Islamisme," *Journal Asiatique* Vol. 4 (1843): 346–47.

Prophet Muhammad famously uttered on Friday 9 *Dzulhijjah* 10 AH:

حَدَّثَنَا مُحَمَّدُ بْنُ سَلاَمٍ، حَدَّثَنَا عَبْدُ الْوَهَّابِ، حَدَّثَنَا أَيُّوبُ، عَنْ مُحَمَّدٍ، عَنِ ابْنِ أَبِي بَكْرَةَ، عَنْ أَبِي بَكْرَةَ ۔ رضى الله عنه ۔ عَنِ النَّبِيِّ ﷺ قَالَ " الزَّمَانُ قَدِ اسْتَدَارَ كَهَيْئَتِهِ يَوْمَ خَلَقَ اللَّهُ السَّمَوَاتِ وَالأَرْضَ، السَّنَةُ اثْنَا عَشَرَ شَهْرًا، مِنْهَا أَرْبَعَةٌ حُرُمٌ، ثَلاَثٌ مُتَوَالِيَاتٌ ذُو الْقَعْدَةِ وَذُو الْحِجَّةِ وَالْمُحَرَّمُ، وَرَجَبُ مُضَرَ الَّذِي بَيْنَ جُمَادَى وَشَعْبَانَ، أَىُّ شَهْرٍ هَذَا ". قُلْنَا اللَّهُ وَرَسُولُهُ أَعْلَمُ. فَسَكَتَ حَتَّى ظَنَنَّا أَنَّهُ سَيُسَمِّيهِ بِغَيْرِ اسْمِهِ، قَالَ " أَلَيْسَ ذَا الْحِجَّةِ ". قُلْنَا بَلَى. قَالَ " أَىُّ بَلَدٍ هَذَا ". قُلْنَا اللَّهُ وَرَسُولُهُ أَعْلَمُ. فَسَكَتَ حَتَّى ظَنَنَّا أَنَّهُ سَيُسَمِّيهِ بِغَيْرِ اسْمِهِ، قَالَ " أَلَيْسَ الْبَلْدَةَ ". قُلْنَا بَلَى. قَالَ " فَأَىُّ يَوْمٍ هَذَا ". قُلْنَا اللَّهُ وَرَسُولُهُ أَعْلَمُ، فَسَكَتَ حَتَّى ظَنَنَّا أَنَّهُ سَيُسَمِّيهِ بِغَيْرِ اسْمِهِ قَالَ " أَلَيْسَ يَوْمَ النَّحْرِ ". قُلْنَا بَلَى. قَالَ " فَإِنَّ دِمَاءَكُمْ وَأَمْوَالَكُمْ ۔ قَالَ مُحَمَّدٌ وَأَحْسِبُهُ قَالَ ۔ وَأَعْرَاضَكُمْ عَلَيْكُمْ حَرَامٌ كَحُرْمَةِ يَوْمِكُمْ هَذَا، فِي بَلَدِكُمْ هَذَا فِي شَهْرِكُمْ هَذَا، وَسَتَلْقَوْنَ رَبَّكُمْ فَيَسْأَلُكُمْ عَنْ أَعْمَالِكُمْ، أَلاَ فَلاَ تَرْجِعُوا بَعْدِي ضُلاَّلاً، يَضْرِبُ بَعْضُكُمْ رِقَابَ بَعْضٍ، أَلاَ لِيُبَلِّغِ الشَّاهِدُ الْغَائِبَ، فَلَعَلَّ بَعْضَ مَنْ يَبْلُغُهُ أَنْ يَكُونَ أَوْعَى لَهُ مِنْ بَعْضِ مَنْ سَمِعَهُ ۔ وَكَانَ مُحَمَّدٌ إِذَا ذَكَرَهُ قَالَ صَدَقَ النَّبِيُّ ﷺ ثُمَّ قَالَ ۔ أَلاَ هَلْ بَلَّغْتُ أَلاَ هَلْ بَلَّغْتُ ". [49]

The Prophet (Muhammad saw.) said, "Time has come back to its original state which it had on the day Allah created the Heavens and the Earth. The year is twelve months, four of which are sacred,

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[49] Muhammad Ibn Abdullah al Khatib al Tabrizy, *Mishkat Al-Masabih* (Dar al-Fikr, 1991), n. 150; Imam Abi Abdullah Ibn Ismal Ismail Ibn Ibrahim Ibn Mughirat Al- Bukhari, "Shahih Bukhari," ed. Imam Mohammed ben Ismail Al-Bukhari, 8th ed. (Beirut: Dar al-Kutub al-'Ilmiyyah, 2017), n. 4160; Abu Husain Muslim bin al Hajjaj, *Shahih Muslim*, 1st ed. (Beirut: Dar al Fikr, n.d.), n. 4160.

three of them are in succession, namely Dhul-Qa'da, Dhul Hijja and Muharram, (the fourth being) Rajab Mudar which is between Juma'da (ath-thamj and Sha'ban. The Prophet (Muhammad saw.) then asked, "Which month is this?" We said, "Allah and his Apostle know better." He kept silent so long that we thought that he would call it by a name other than its real name. He said, "Isn't it the month of Dhul-Hijja?" We said, "Yes." He said, "Which town is this?" We said, "Allah and His Apostle know better." He kept silent so long that we thought that he would call it t,y a name other than its real name. He said, "isn't it the town (of Mecca)?" We replied, "Yes." He said, "What day is today?" We replied, "Allah and His Apostle know better." He kept silent so long that we thought that he would call it by a name other than its real name. He said, "Isn't it the day of Nahr?" We replied, "Yes." He then said, "Your blood, properties and honor are as sacred to one another as this day of yours in this town of yours in this month of yours. You will meet your Lord, and He will ask you about your deeds. Beware! Do not go astray after me by cutting the necks of each other. It is incumbent upon those who are present to convey this message to those who are absent, for some of those to whom it is conveyed may comprehend it better than some of those who have heard it directly." (Muhammad, the sub-narrator, on mentioning this used to say: The Prophet then said, "No doubt! Haven't I delivered (Allah's) Message (to you)? Haven't I delivered Allah's message (to you)?

This utterance is, in all likelihood, a reference to the calendrical alignments of the Jewish and Hijri calendar. As the 9th of *Dzulhijjah* 10 AH was the equivalent of the 9th of Adar II AM 4392 (which is the 13th intercalary month of the Hebrew calendar and which was the equivalent of 7 March AD 632) the 1st *Muharram* of the year 11 AH would have fallen on the 1st of Nisan AM 4392.

The Muslim was aware of different calendars is alluded in the Qur'an surah Al-Kahfi verse 25:

وَلَبِثُوا فِي كَهْفِهِمْ ثَلٰثَ مِائَةٍ سِنِيْنَ وَازْدَادُوا تِسْعًا

And they stayed in their Cave three hudred years, and added nine more. (QS. Al-Kahfi/18: 25)[50]

That Qur'an tells us about the Companions of the Cave. Clearly the interlocutors of the Qur'an would have understood the reference to 300 years an allusion to the solar calendar and the 309 years to have been the equivalent period of time in lunar years.

The observance of the lunar calendar is clearly mentioned in the Qur'an Surah Yunus verse 5:

هُوَ الَّذِيْ جَعَلَ الشَّمْسَ ضِيَآءً وَّالْقَمَرَ نُوْرًا وَّقَدَّرَهٗ مَنَازِلَ لِتَعْلَمُوا عَدَدَ السِّنِيْنَ وَالْحِسَابَّ
مَا خَلَقَ اللّٰهُ ذٰلِكَ إِلَّا بِالْحَقِّ يُفَصِّلُ الْاٰيٰتِ لِقَوْمٍ يَّعْلَمُوْنَ

He (Allah) is Who made the sun radiate a brilliant light and the moon reflect a lustre, and ordained for it stages, that you might kno the number of year and the reckoning of time. Allah has not created this but in truth. He details the Signs for a people who have knowledge. (QS. Yunus/10: 5)[51]

The Quraysh would have embraced the system of intercalation (embolism) from the Jews without following the latter's

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[50] Maulawi Sher 'Ali, *The Holy Qur'an: Arabic Text and English Translation*, 10th ed. (United Kingdom: Islam International Publications Ltd, 2021), 417.

[51] Ibid., 285.

methodology. As the great polymath al-Biruni observed, the system intercalation "was borrowed from the Jews approximately 200 years before Islam" By Hudhayfah, the first intercalator of the tribe of Kinanah. Al Biruni adds that the addition of an intercalary month was (administered by the *nasa'a* of the Kinanah who were known as "The Qalamis"). It is therefore plausible that the Quraysh transposed the Hebrew months to Araboan months following the below sequence:

No	Hebrew Month	Hijri Month
1	*Nisan*	*Muharram*
2	*Iyyar*	*Safar*
3	*Sivan*	*Rabiul Awal*
4	*Tammuz*	*Rabiul Akhir*
5	*Av*	*Jumadil Awal*
6	*Elul*	*Jumadil Akhir*
7	*Tishri*	*Rajab*
8	*Marheshvan*	*Sya'ban*
9	*Kislev*	*Ramadhan*
10	*Tevet*	*Syawal*
11	*Shavat*	*Dzulqa'dah*
12	*Adar I*	*Dzulhijjah*
13	*Adar II*	*Nasi'i*

Table 2. 1 Name of Hebrew Month and Hijri Month[52]

Whenever an embolism was applied, the intercalary month of Adar II would have become the equivalent of the month of *nasi'* in

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[52] Ibrahim Zein and Ahmed El-Wakil, "On the Origins of the Hijrı Calendar: A Multi-Faceted Perspective Based on the Covenants of the Prophet and Specific Date Verification," *Religions* Vol 12 (2021): 4.

the Jewish-Arabian calendar. With the passage of time, there would have been a gap between the actual lunar month of *Dzulhijjah* and the luniolar month of *Dzulhijjah*. When the Muslim performed the lesser pilgrimage in the month of *Dzulhijjah* on the Jewish-Arabian calendar. In 10 AH, the month of Adar II would have been the month of *Dzulhijjah* on the Hijri calendar and the additional month of *nasi*' on the Jewish-Arabian calendar. The fact that the Prophet Muhammad knew that the Farewell Pilgrimage in *Dzulhijjah* 10 AH a the correct date for the pilgrimage, clearly demonstrates knowledge and observance of a lunar calendar alongside a lunisolar Jewish-Arabian calendar.

In the tenth year of the Hijra, as documented in the Qur'an Surah At-Tawbah verse :36–37, Muslims believe God revealed the "prohibition of the *Nasī*".

فَلَا تَظْلِمُوْا فِيْهِنَّ اَنْفُسَكُمْ وَقَاتِلُوا الْمُشْرِكِيْنَ كَآفَّةً كَمَا يُقَاتِلُوْنَكُمْ كَآفَّةً ۗوَاعْلَمُوْٓا اَنَّ اللّٰهَ مَعَ الْمُتَّقِيْنَ (٣٦) اِنَّمَا النَّسِيْٓءُ زِيَادَةٌ فِى الْكُفْرِ يُضَلُّ بِهِ الَّذِيْنَ كَفَرُوْا يُحِلُّوْنَهٗ عَامًا وَّيُحَرِّمُوْنَهٗ عَامًا لِّيُوَاطِئُوْا عِدَّةَ مَا حَرَّمَ اللّٰهُ فَيُحِلُّوْا مَا حَرَّمَ اللّٰهُ ۖزُيِّنَ لَهُمْ سُوْۤءُ اَعْمَالِهِمْ ۗوَاللّٰهُ لَا يَهْدِى الْقَوْمَ الْكٰفِرِيْنَ (٣٧)

The reckoning of month with Allah has been twelve month by Allah's ordinance since the day when He created the heavens and the earth. Of these, four are sacred. That is the right creed. So wrong not yourselves therein. And fight the idolaters all together as they fight you all together; and know that Allah is with the righteous. surely, the postponement of a Sacred month is an addition to disbelief. Those who disbelieve are led astray thereby.

They allow it one year and forbid it another year, that they may agree in the number of the months which Allah ha made sacred, and thus may make lawful what Allah has forbidden. The evil of their deeds is made to seem fair to them. And Allah guides not the disbelieving people. (QS. At-Taubah/9:36-37)[53]

The prohibition of Nasī' would presumably have been announced when the intercalated month had returned to its position just before the month of Nasi' began. If Nasī' meant intercalation, then the number and the position of the intercalary months between AH 1 and AH 10 are uncertain; western calendar dates commonly cited for key events in early Islam such as the Hijra, the Battle of Badr, the Battle of Uhud and the Battle of the Trench should be viewed with caution as they might be in error by one, two, three or even four lunar months. This prohibition was mentioned by Muhammad during the farewell sermon which was delivered on 9 Dhu al-Hijjah AH 10 (Julian date Friday 6 March 632 CE) on Mount Arafat during the farewell pilgrimage to Mecca.

Certainly the Nasi' is an impious addition, which has led the infidels into error. One year they authorise the Nasi', another year they forbid it. They observe the divine precept with respect to the number of the sacred months, but in fact they profane that which God has declared to be inviolable, and sanctify that which God has declared to be profane. Assuredly time, in its revolution, has returned to such as it was at the creation of the heavens and the

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[53] 'Ali, *The Holy Qur'an: Arabic Text and English Translation*, 264.

earth. In the eyes of God the number of the months is twelve. Among these twelve months four are sacred, namely, Rajab, which stands alone, and three others which are consecutive.[54]

The three successive sacred (forbidden) months mentioned by Prophet Muhammad (months in which battles are forbidden) are Dhu al-Qa'dah, Dhu al-Hijjah, and Muharram, months 11, 12, and 1 respectively. The single forbidden month is Rajab, month 7. These months were considered forbidden both within the new Islamic calendar and within the old pagan Meccan calendar.

3. History of The Hijri Calendar After Join Islam

This Hijri calendar begins since the responsibility for leadership of the Islamic Ummah is in the hands of Umar bin Khatab, which is 2.5 years since he was appointed caliph to replace the caliph Abu Bakr as-Siddiq.

One day, there was a problem involving a document appointing Abu Musa al-Asy'ari as governor in Basrah which occurred during the month of Sha'ban. The question arises which month of Sha'ban?[55] In addition, when Abu Musa al-Asy'ari became governor, he received a letter from caliph Umar bin Khattab which had no year number. This often happened every time the caliph

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[54] Sherrard Beaumont Burnaby, *Elements of the Jewish and Muhammadan Calendars : With Rules and Tables and Explanatory Notes on the Julian and Gregorian Calendars* (London: G. Bell, 1901), 370.

[55] Muhyiddin Khazin, *Ilmu Falak Dalam Teori Dan Praktek* (Yogyakarta: Buana Pustaka, 2004), 110.

Umar sent a letter, only the date and month without the year number. Meanwhile, a letter without a record of the year will be problematic and become a serious problem if it is archived in the state administration.[56] Therefore, Umar bin Khattab summoned several prominent friends to discuss the issue so that this kind of problem would not happen again.

So the Hiriah calendar was created, calculated starting from the year in which the migration of the Prophet Muhammad from Mecca to Medina took place. Thus the hijri calendar is applied backwards by 17 years.[57]

The event of the migration of the Prophet Muhammad and his followers from Mecca to Medina was chosen as the starting point for calculating the year. Because this event is a major event in the early history of the development of Islam. The Hijrah event was the first major sacrifice made by the Prophet Muhammad and his followers for the Islamic faith, especially during its early development.[58]

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[56] E. Dermawan Abdullah, *Jam Hijriah* (Jakarta: Pustaka Al-Kautsar, 2011), 70–71.

[57] Khazin, *Ilmu Falak Dalam Teori Dan Praktek*, 110.

[58] Slamet Hambali, *Almanak Sepanjang Masa: Sejarah Sistem Penanggalan Masehi, Hijriah Dan Jawa*, ed. Abu Rokhmad (Semarang: Program Pascasarjana IAIN Walisongo Semarang, 2011), 59.

C. Algorthm of the Hijri Calendar

Ideally, a Hijri month starts on the sunset after the new moon, the first night in which the moon will be up for at least certain time after the sunset. There are two criteria, specified in the al-Qur'an, regarding the start of a new month are the new month start at the earliest sunset which occurs after the sun-moon conjunction and before the moon sets.

1. Overview Arithmetic Algorithms

From 9th century CE, reasonably accurate arithmetic calendars were in practice, which is still used in most of the Islamic countries. A lunar month on average has 29,530589 days. Assuming it is 29,5 days, and the months are set to have 30 and 29 days alternately, we get 29,5 x 12 = 354 days. This is 0,367068 days less than 29,530589 x 12 = 354, 367068. Since this is very close to $\frac{11}{30}$ = 0,3666666, adding 11 leap months every 30 years was considered to be pretty accurate.

Since twelve lunar months add up to about 354 days, the twelve-month-cycles of the Islamic calendar occur some eleven days earlier each year, and the individual months move forward through the season. To keep the lunar months in line with the seasons of the solar year it was the custom in pre-Islamic times to insert an additional 'intercalary' month in the lunar calendar every few years. This practice the prophet Muhammad abandoned. The Al-Qur'an expressly forbids such intercalation, and the exegetes explain that the proscription was necessary because intercalation caused months

that god had intended to be holy to be confused with the other month. [59]

The Islamic calendar is a straightforward, strictly lunar calendar, with no intercalation of months. The average lunar year is about 354 $\frac{11}{30}$ days, so the Islamic calendar's independence of the solar cycle means that its months do not occur in fixed seasons but migrate through the solar year over a period of about 32 solar years.1 Days begin at sunset.[60] The main time interval between two consecutive New Moon is 29.53089 days, or 29 days 12 hours 44 minutes 03 second. This is the length of the synodic period of the moon.[61]

One period of the moon is, on the average, 29.53059 days. 11 days more than 12 lunar periods, which amount to 354.3671 days. After three years the moon calendar is 33 days behind the sun's progress. In order to remain in accordance with the sun, every third year, sometimes oftener, an extra month had to be added, so that the year had 13 instead of 12 months.[62]

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[59] David A. King, *Astronomy in The Service of Islam* (Aldershot: Varioum, 1993), 247.

[60] Edward M. Reingold, *Calendrical Calculation: The Ultimate Edition*, 4th ed. (Cambridge: Cambridge University Press, 2018), 105.

[61] Jean Meeus, *Astronomical Algorithms*, 2nd ed. (Richmond: Willman-Bell, 1991), 354.

[62] A. Pannekoek, *A History of Astronomy* (New York: Interbulence, 1960), 25.

The year had 13 instead of 12 mounts that is in the years 2, 5, 7, 10, 13, 16, 18, 21, 24, 26, 29. That mean, in the span of 30 years (or 360 months), the number of days is 30 X 354 + 11 = 10631 days. The average for one month is equal to 10631/360 = 29.530556 days. This figure is very close to the average synodic month, which is 29.530589 days. The difference in one month is 0.000033 days, or it becomes equal to 1 day in about 30,000 months (2500 years). This difference is very small. Until now, the Islamic year is still around 1400's, so there is no need to make corrections.[63]

The odd-numbered month have 30 days while the even numbered months have 29 days. The twelfth month will have 30 days on leap years which happens 11 times in 30 years.

2. Leap Year Variations

The oldest and most popular convention is to use the years 2, 5, 7, 10, 13, 16, 18, 21, 24, 26 and 29 in the 30-year cycles as leap years. Some scholars suggested alternate leap year schemes. The following are thr schemes suggested.

    a. One popular convertion is to use the years 2, 5, 7, 10, 13, 16, 18, 21, 24, 26 and 29 in the 30-year cycle. This is what many books on Arabic calendar, emacs calendar etc use ICU also use this convention.

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[63] Rinto Anugraha, *Mekanika Benda Langit* (Yogyakarta: Universitas Gajah Mada, 2012), 15.

b. Another convention has a small variation from the above. It considers the 16th years as non-leap and 15th as leap. The result is, it may have one day difference in some months on two years in a 30-years cycle. MS Outlook Calendar uses this.

c. Yet another convention considers years 2, 5, 8, 10, 13, 16, 19, 21, 24, 27 and 29. Called Fatimid (Misri/Bohra) calendar.

d. Another one with 2, 5, 8, 11, 13, 16, 19, 21, 24, 27 and 30. Not used modern times.

3. Epoch Variations

Since arithmetic algorithms base on arotmetic calculations rather than the actual astronomical phenomenon, it has to take a base point in time as the starting point (epoch).

The calendar started on a sunset on July 15, 622 CE (Julian), and there are two conventions to fix first day of the calendar. People are stil debating whether the prvious day or the next day should be considered for arithmetic calendars.

a. The popular approach is to take the next day (Friday, juli 16, 622 CE) as the first day. This is the called the Friday epoch of the calendar.

b. Another approach is to consider the previous day (Thursday, July 15, 622 CE) as the epoch. This is the called the Thursday epoch.

Since the calendar is not astronomical, these systems will have one day difference in general. Because of these variations, there are 8 different arithmetic calendars, not all of which are used.

Epoch/Leap Scheme	Thursday Epoch	Friday Epoch
1	Not used	ICU, Emacs, Many Books and online calendar
2	MS Outlook	Not used
3	Fatmid/Bohra	Not used
4	Not used	Not used

Table 2. 2 Table Variations of the Hijri Calendar[64]

4.   Variations of Arithmetic Algorithms

Based on the information in the last section, the following are the variations of arithmetic Hijri calendars.

The standard Hijri Calendar, used by ICU, Emacs Calendar, many online calendars and algoritms given in many books, including calendrical calculation and mapping time: the calendar and its history. Uses leap scheme 1 and Friday epoch. Popular in some Islamic countries.

The Kuwaiti Hijri calendar, used by Mocrosoft Outlook. Uses leap scheme 2 and the Thursday epoch. Popular in Kuwait.

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[64] Umesh Nair, "The Hijri Calendar," 2009, 4.

The Fatmid "Astronomical" calendar, used by the Dawoodi Bohras, around 2 milion people throughout the world. Uses leap scheme 3, Thursday epoch.

D. The New Criteria of MABIMS to Hijri Calendar

There are two ḥisāb criteria used in the preparation of the Hijriyah calendar. First, the requirements for the form of the moon crescent as used in preparing the Muhammadiyah and Ummul Qura calendars in Saudi Arabia.Second, the criteria for imkān al-ru'yah (Kriteria Imkanur Rukyah/KIR) as used in the preparation of the Hijriyah Takwim calendar by the Minister of Religion of Brunei, Indonesia, Malaysia and Singapore/MABIMS member countries.[65]

The MABIMS imkān al-ru'yah (moon crescent visibility) criteria in 2016 changed from the old measures, namely the height of the moon crescent 2º, the elongation 3º or the age of the moon 8 hours, to the new criteria, namely the height of the moon crescent 3º and elongation of 6.4º.

The discussion determines the diversity of criteria of imkān al-ru'yah in the representative of its member countries. Muzakarah Rukyah and the 16th Islamic Takwim Member State in the MABIMS deliberation on 2-4 August 2016 provided the following recommendations:

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[65] Maskufa et al., "Implementation of the New MABIMS Crescent Visibility Criteria: Efforts to Unite the Hijriyah Calendar in the Southeast Asian Region," *Al Ahkam* vol 22, no. 1 (2022): n. 211.

First, The criteria for *imkān al-ru'yah* for MABIMS member countries in determining the Hijriyah Takwim and the beginning of the Hijriyah month are: "when the sun sets, the height of the moon crescent is not less than 3º from the horizon and the angle of elongation is not less than 6.4º". Second, the elongation angle parameters are from the center of the moon to the center of the sun.

Third, implementing these criteria in the preparation of the Hijri *takwim* will begin in 2018/1439H. Fourth, the imaging technique may be used in *ru'yat al-hilāl* following the conditions: a). takes effect after sunset; b). astronomer is a Muslim and just; and c). the equipment used maintains the ru'yah principle. The global Hijriyah Takwim reserves decided at the 2016 Istanbul Global Hijriyah Takwim congress were refined by member countries. Last, the study of the moon crescent will be continued. The new MABIMS moon crescent visibility criteria result from a study based on fiqh arguments and astronomical science.

CHAPTER III

THE ACEH HIJRI CALENDAR

A. Proof of the Existence of the Aceh Hijri Calendar

This thesis is supported by several facts, including the fact that the people of Aceh have their own calendar system. The calendar system was adopted from the Hijri calendar system.

    1. First Islam and First Islamic Astronomy in Indonesia

Islam and astronomy (Falak science) cannot be separated. This is because astronomy is needed to determine the time and direction of daily Muslim activity. So it can be concluded that the early development of Islam and astronomy in the archipelago was based on the development of the Islamic empire in the archipelago with the establishment of the Samudera Pasai Kingdom. This shows that Aceh was the first region to develop astronomy in the archipelago. The Samudera Pasai Sultanate was founded by Sultan Malik As-Saleh. This is evidenced by the discovery of the remains of a tomb belonging to Sultan Malik As-Saleh, which is located in village Beuringen village, Samudera district, Aceh province.[66] Not only the tomb of the first sultan of the Samudra Pasai kingdom, but the tombs of other sultans also used the Hijri calendar. Based on this, it can be proven that activities in the Samudera Pasai kingdom use the Hijri calendar.

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[66] Mirsa et al., "Space Pattern of Samudera Pasai Sultanate," 94.

The Hijri calendar has been known and used in Aceh since the Samudra Pasai kingdom, which existed from the 7th/13th century to 10 H/16 AD, as seen in the size of the tombstones left by the Samudra Pasai kingdom, which recorded the date of death of the royal leaders at that time with the calendar hijri.[67]

The Hijri calendar continued to be seen in use until the Darussalam Kingdom ended due to colonialism. The hijri calendar in every period of government in the kingdom of Aceh Darussalam can be seen from every letter written from the kingdom which also always uses the hijri calendar.[68] In addition to the evidence of letters, the book of astronomy which discusses the Hijri calendar also existed at that time which was written by Abbas Kuta Karang.[69] Therefore, the Hijri calendar for the people of Aceh is well known and implemented in life, coupled with the existence of traditional rituals that are very closely related to the Hijri calendar.

Culture of *Khanduri apam* (*serabi*) which has become a ritual for the people of Aceh in welcoming the Isra' Mi'raj in the month

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[67] Ismail, "Sistem Kalender Pada Masa Kerajaan Samudra Pasai," 101–22.

[68] Ismail Ismail and Bastiar Bastiar, "Dinamika Kalender Hijriah Dalam Qanun Syari'at Islam Provinsi Aceh," *Al-Qalam: Jurnal Penelitian Agama Dan Sosial Budaya* Vol 26, no. 2 (November 2, 2020): 255–66.

[69] Putri and Qadir, "Aceh Local Wisdom In The Method of Determining The Hijri Calendar," 52–72.

of *Rajab*.[70] Abstinence from going to the rice fields every Wednesday at the end of the month in the Hijri calendar where the people of Aceh know this taboo as Nahah (naas) day.[71] There are many religious rituals in Aceh, such as the commemoration of 1 Muharram, the birthday of the Prophet, which is celebrated for up to 4 months (*rabiul Awal, Rabiul Akhir, Jumadil Awal* and *Jumadil Akhir*). *Khanduri Ashura* which is always performed on the 10th of *Muharram* and *khanduri buruat* or *khanduri nisfu Sya'ban* which is always performed on the 15th night of *Sha'ban*.[72]

2. The Several Manuscripts

There are several manuscripts written by scholars who are the leaders of community, about how to count the days at the beginning of each Hijri month. In this thesis, there are two manuscripts which are the main reference sources in analyzing the Aceh Hijri Calendar algorithm. manuscript *Risalah Asy-Shaykh 'Abd Ar-Rauf fi At-Taqwim* which is a manuscript about Sheikh Abdur Rauf Singkil (Syiah Kuala) explaining the method of determining the day at the beginning of the Hijri month[73] and the

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[70] Khusna Boru Tumeang, "Tradisi Khanduri Apam Pada Masyarakat Adat Gampong Reusak Kecamatan Samatiga Kabupaten Aceh Barat" (Universitas Syiah Kuala, 2018).

[71] Rahmatul Maulida, "Rabu Nehah (Studi Etnografi Tentang Larangan Turun Kesawan Pada Masyarakat Gampong Paloh Kayee Kunyet Kecamatan Nisam)," *Aceh Anthropological Journal* Vol 1, no. 1 (2017): 59–79.

[72] Zahrina, *Al-Manak Hijriah Di Aceh.*

[73] Cosara, Junaidi, and Ansori, "Hisab Awal Bulan Syiah Kuala (Menyunting Dari Naskah Risalah Asy-Syaikh 'Abd ArRauf Fi At-Taqwim)."

manuscript *Ilmu Falak Teuku Imum Lhok Kaju* which contains a table of the first day of the Hijri month Calendar.[74]

3. Books

There are books written by present-day scholars and one of the orientalists who researches Aceh, we known as Abdul Ghafur or Christian Scouck Hurgronje. In this thesis, there are two books which are the main sources in analyzing the Aceh Hijri Calendar algorithm. a book with the title *Tajul Muluk* written by Syeh Ismail Aceh which explains the method of determining the day at the beginning of the Hijri month and the day table for each letter of the year and month of Hijri[75] and the Acehnese book written by Christiaan Snouck Hurgronje which explains the method of calculating the hijri calendar used by the people of Aceh.[76]

B. Mean of the Aceh Hijri Calendar

A long time ago, the calendar had a system based on the customs and understanding of a group of people referring to the heavenly bodies. The system is divided into the solar system, the lunar system, and the sun-moon stsrem (lunar system). In Indonesia, which is famous for its various ethnicities, races, and cultures, the calendar system is diverse and influential in the lives of previous generations. There is a calendar system written in the characters used in carrying out daily activities. The

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[74] Pedir Museum, "Naskah Ilmu Falak Teuku Imum Lhok Kaju."
[75] Syaikh Ismail Al-Asyi, *Tajul Mulk*, 28.
[76] Hurgronje, *Orang Aceh Budaya, Masyarakat, Dan Politik Kolonial*.

existence of knowledge and manuscripts is what needs to be known and preserved as relics of the ancestors.[77]

The people of Aceh know the Hijri calendar as a calendar used for historical, cultural, or religious calendars. This is because the people of Aceh are a devout Muslim community. This results in culture and tradition in carrying out calendar activities in a year.

The emergence of the Hijri calendar, combined with calendar records between the Acehnese calendar and the Islamic calendar, is united and conditioned as a record of historical events formed in the celebration of the traditions and culture of the Acehnese people. For the people of Aceh Setipa, not in the Hijri year, there is a mention of a special name and a special celebration.

Records of historical events based on the Hijri calendar also contain celebrations that have become traditions for the people of Aceh. so that the name of the month in the Aceh Hijri calendar follows the name of the month of Aceh or is called *Uroe Buleuen Aceh*. The Aceh Hijri calendar starts at night. The names of the mentions of Acehnese uroe buleun contained in the Aceh Hijri calendar are as follows:

NO	HIJRI MONTH	ACEH HIJRI MONTH
1	*Muharam*	(*Asan Usen*) due to commemorate the death of Hasan and Husain on the 10th of this month
2	*Safar*	(*sapha*)
3	*Rabiul Awal*	(*Mo'lot*) which is taken from the Arabic *Mawlid*, that to celebration of the birth of the Prophet Muhammad, sometimes also called *Rabi'oy Away*
4	*Rabiul Akhir*	(*Adoe Mo'lot*) literally means after *Mo'lot*, because the birth of Prophet Muhammad is also commemorated in this month. Rarely mentioned *Rabi'oy Akhe*
5	*Jumadil Awal*	(*Mo'lot Seuneulheueh*) that is the last *Mo'lot* because this month is specifically dedicated to commemorating the birth of the Prophet Muhammad. Women, who still adhere to everything related to ancient Acehnese customs in a conservative manner, also call this month the name *Madika Phon*, which means "the first month of independence". This month is rarely mentioned *jamado-Away*.
6	*Jumadil Akhir*	(*Kanduri Boh Kayee*) that is "*kenduri* or offering of fruits of religious value". Women who are loyal to old customs call it as *Madika Seuneulheueh* which means "the last month of independence". This month is rarely mentioned *Jamado Akhe*.
7	*Rajab*	(*Kanduri Apam*) that is *kenduri kue Apem*, which mean "celebration of apam cake" or called *Rajab* or *Ra'jab*.
8	*Sya'ban*	(*Kanduri Bu*) that is "rice celebration" who called *Cha'ban* or *Sa'ban*
9	*Ramadhan*	(*Puasa*) or *Ramalan* or *Ramulan*
10	*Syawal*	(*Uroe Raya*) month of celebration or *Chaway*
11	*Dzulqa'dah*	(*Meu'apet*) "Cracked Moon, Pinched" compare with *apit* or *hapit* in Malay, Java and Sundanese language or *Doy Ka'idah*
12	*Dzulhijjah*	(Haji) or *Doy Hijah*

Table 3. 1 Month Name in Arabic language and in Aceh language[78]

Besides the names of the months that have been determined, the people of Aceh have agreed on the names of the days in one week, and the number of days in one week is seven. The names of the days that have been determined are:

> *Aleuhad* is the name for the day Sunday
> *Seunayan* is the name for the day Monday
> *Seulasa* is the name for the day Tuesday
> *Rabu* is the name for the day Wednesday
> *Hameh* is the name for the day Thursday
> *Djeumeu'at* is the name for the day Friday
> *Satu* is the name for the day Saturday [79]

C. Kinds of the Aceh Hijri Calendar

Actually, the Aceh Hijri calendar is still used by some Acehnese. The calendar they used does not have a definite algorithm; there are several methods of calculating the Aceh calendar popularized by astronomers in Aceh.

1. Calculation of the manuscript *risalah asy-syaikh 'abd ar rauf fi taqwim.*
2. Calculation of the book *Tajul Muluk* from Syeh Ismail Aceh.
3. Calculation of the book The Acehnese from C. Scouck Hurgronje.
4. Language transfer from Arabic language to Aceh language.

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[78] Zahrina, *Al-Manak Hijriah Di Aceh*, 5–6.
[79] Ibid., 6.

Calendars that only change from Arabic to Acehnese usually use a modern calculation system. This is because this calendar is a Hijri calendar with modern calculations that was then changed to the Acheh language. so that this calendar eliminates the characteristics of the Aceh Hijri calendar, which uses year letters and month letters.

In the manuscript *risalah asy-syaikh 'abd ar rauf fi taqwim,* book of *Tajul Muluk* and calculation in book The Acehnese have the same calculation method. That is determine the year to be calculated and divided by 8. The remainder of the division will be converted into the letters of the year it consists of أهجزدبود, which is calculated from the letter و (*waw*).

Every month of the Hijri calendar has its own letters. Starting from the month of Muharram which is lettered ز (*zai*), Shafar is lettered ب (*ba*), Rabiul awal is lettered ج (*jim*), Rabiul Akhir is lettered ه (*ha*), Jumadil Awal is lettered و (*waw*), Jumadil Akhir is lettered أ (*alif*), Rajab is lettered ب (*ba*), Sya'ban is lettered د (*dal*), Ramadhan is lettered ه (*ha*), Syawal is lettered ز (*zai*), Dzulqa'dah is lettered أ (*alif*), and Dzulhijjah is lettered ج (*jim*).

To find the beginning day of the month, add up the year letter and the month letter. Start counting from the day of Wednesday as well as the sum of the year letter and the month letter.

Over time, the Hijri calendar is growing. so that the Aceh Hijri calendar calculation method does not update. Because of this, the people of Aceh abandoned the Aceh Hijri calendar and used the Hijri calendar as a calendar in their daily lives. However, the language used in the Hijri calendar is changed to Acehnese and adapted to the social conditions that exist in Acehnese society.

D. Jumali Letter or Hindi Letter

In the Acehnese Hijri calendar system, many of them use the Jumali model in writing numbers. Jumali is a number model commonly used by ancient reckoning scholars to present astronomical data on celestial bodies. [80] The jumali number uses Arabic letters:

ابجد هوز حطيك لمن # سعفص قرش تثخذ ضظغ

Unit		Tens		Hundreds		Thousands	
1	ا	10	ي	100	ق	1000	غ
2	ب	20	ك	200	ر	2000	بغ
3	ج	30	ل	300	ش	3000	جغ
4	د	40	م	400	ت	4000	دغ
5	ه	50	ن	500	ث	5000	هغ

[80] Muhyiddin Khazin, *Kamus Ilmu Falak*, 1st ed. (Jogjakarta: Buana Pustaka, 2005), 41.

Unit		Tens		Hundreds		Thousands	
6	و	60	س	600	خ	6000	وغ
7	ز	70	ع	700	ذ	7000	زغ
8	ح	80	ف	800	ض	8000	حغ
9	ط	90	ص	900	ظ	9000	طغ

Table 3. 2 Letters and numbers using Arabic letters [81]

E. Table The Beginning Day of The Aceh Hijri Calendar

The ancient Acehnese scholars used the table for determining the day at the beginning of the Aceh Hijri calendar month to make it easier to determine the start day of the month. There are two different versions of the table. In the book *Tajul Muluk* has the following table:

د ٤	و ٦	ب ٢	د ٤	ز ٧	ج ٣	ه ٥	ا ١	حرف بولن	نة بولن
سبت أحد	اثنين ثلاثاء	خميس جمعة	سبت أحد	ثلاثاء أربعاء	جمعة سبت	احد اثنين	اربعاء خميس	ز ٧	حمل
اثنين ثلاثاء	اربعاء خميس	سبت احد	اثنين ثلاثاء	خميس جمعة	احد اثنين	ثلاثاء اربعاء	جمعة سبت	ب ٢	ثور

    [81] Hambali, *Almanak Sepanjang Masa: Sejarah Sistem Penanggalan Masehi, Hijriah Dan Jawa*, 62.

اسم بولن	حرف بولن	ا ١	هـ ٥	ج ٣	ز ٧	د ٤	ب ٢	و ٦	د ٤
ربيع أول ٣	ج ٣	سبت أحد	اربعاء خميس	اثنين ثلاثاء	جمعة سبت	ثلاثاء أربعاء	احد اثنين	خميس جمعة	ثلاثاء أربعاء
ربيع آخر ٥	هـ ٥	اثنين ثلاثاء	خميس جمعة	اربعاء خميس	احد اثنين	خميس جمعة	ثلاثاء اربعاء	سبت احد	خميس جمعة
جماد أول ٦	و ٦	ثلاثاء أربعاء	سبت احد	خميس جمعة	اثنين ثلاثاء	جمعة سبت	اربعاء خميس	احد اثنين	جمعة سبت
جماد آخر ١	ا ١	خميس جمعة	احد اثنين	سبت احد	اربعاء خميس	احد اثنين	احد اثنين	ثلاثاء اربعاء	احد اثنين
رجب ٢	ب ٢	جمعة سبت	ثلاثاء اربعاء	احد اثنين	خميس جمعة	اثنين ثلاثاء	سبت احد	اربعاء خميس	اثنين ثلاثاء
شعبان ٤	د ٤	احد اثنين	خميس جمعة	ثلاثاء اربعاء	سبت احد	اربعاء خميس	احد اثنين	خميس جمعة	اربعاء خميس
رمضان ٥	هـ ٥	اثنين ثلاثاء	جمعة سبت	اربعاء خميس	احد اثنين	خميس جمعة	ثلاثاء اربعاء	سبت احد	خميس جمعة

ناة بولن	حرف بولن	ا ١	ه ٥	ج ٣	ز ٧	د ٤	ب ٢	و ٦	د ٤
شوال	ز ٧	اربعاء خميس	احد اثنين	جمعة سبت	ثلاثاء اربعاء	سبت احد	خميس جمعة	احد اثنين	سبت احد
ذوالقعدة	ا ١	خميس جمعة	اثنين ثلاثاء	سبت أحد	اربعاء خميس	احد اثنين	جمعة سبت	ثلاثاء اربعاء	احد اثنين
ذوالحجة	ج ٣	سبت احد	اربعاء خميس	اثنين ثلاثاء	جمعة سبت	ثلاثاء اربعاء	احد اثنين	خميس جمعة	ثلاثاء اربعاء

Table 3. 3 The beginning day of each Hijri month in the book of Tajul Muluk[82]

There is also a table of the beginning of the day based on *Jumali* data or based on Hindi letters as explained in the teuku imum lhok kaju astronomy manuscript:

	ا ١	ه ٥	ج ٣	ز ٧	د ٤	ب ٢	و ٦	د ٤
محرم	ز ٧	ز ٧	ز ٧	ز ٧	ز ٧	ز ٧	ز ٧	ز ٧

[82] Syaikh Ismail Al-Asyi, *Tajul Mulk*, 13.

	د ٤	و ٦	ب ٢	د ٤	ز ٧	ج ٣	هـ ٥	ا ١
صفر	ب ٢	ب ٢	ب ٢	ب ٢	ب ٢	ب ٢	ب ٢	ب ٢
ربيع أول	ج ٣	ج ٣	ج ٣	ج ٣	ج ٣	ج ٣	ج ٣	ج ٣
ربيع آخر	هـ ٥	هـ ٥	هـ ٥	هـ ٥	هـ ٥	هـ ٥	هـ ٥	هـ ٥
جماد أول	و ٦	و ٦	و ٦	و ٦	و ٦	و ٦	و ٦	و ٦
جماد آخر	ا ١	ا ١	ا ١	ا ١	ا ١	ا ١	ا ١	ا ١
رجب	ب ٢	ب ٢	ب ٢	ب ٢	ب ٢	ب ٢	ب ٢	ب ٢
شعبان	د ٤	د ٤	د ٤	د ٤	د ٤	د ٤	د ٤	د ٤
رمضان	هـ ٥	هـ ٥	هـ ٥	هـ ٥	هـ ٥	هـ ٥	هـ ٥	هـ ٥
شوال	ز ٧	ز ٧	ز ٧	ز ٧	ز ٧	ز ٧	ز ٧	ز ٧
ذوالقعدة	ا ١	ا ١	ا ١	ا ١	ا ١	ا ١	ا ١	ا ١

	د	و	ب	د	ز	ج	هـ	ا
	٤	٦	٢	٤	٧	٣	٥	١
ذوالحجة	ج	ج	ج	ج	ج	ج	ج	ج
	٣	٣	٣	٣	٣	٣	٣	٣

Table 3. 4 Table of the beginning day of the Hijri month in the
manuscript of ilmu falak Teuku Imum Lhok Kaju

Basically, the two tables have different ways of writing the
beginning of the day at the beginning of the Hijri calendar month. This
is because the first table discusses the beginning of the day at the
beginning of the Hijri month, while the second table discusses the year
and month letters, but they use the same calculation formula.

CHAPTER IV

REFORMULATION OF THE ACEH HIJRI CALENDAR ALGORITHM

A. Method of the formula of the Aceh Hijri Calendar

As explained in the chapter III, the Aceh Hijirah calendar calculation has the years letters consisting of the Arabic letter أحجزدبود and The Aceh Hijri calendar starts its calculations from the letter و. That is because the arrangement of the letters will become:

No	Years Letter	Jumali/Hindi
1	و	6
2	د	4
3	ا	1
4	هـ	5
5	ج	3
6	ز	7
7	د	4
8	ب	2

Table 4. 1 Years letter's with jumali number

From that table, there is a number pattern in the Jumali/Hindi results in year letters indicating whether the year is a leap year or a common year:

Year Letter	و	د	ا	ه	ج	ز	د	ب
Hindi/Jumali	6	4	1	5	3	7	4	2
Addition	+5	+4	+4	+5	+4	+4	+5

Table 4. 2 Years letter and his addition

From that explanation, it can be understood that the Aceh Hijri calendar has 8 years, with 3 years of leap years and 5 years of common years. If calculated for one year, the Aceh Hijri calendar produces 354 days and 9 hours. It is based on:

$$\frac{3 \; days}{8 \; years} x \; 24 \; Hour = 9 \; Hour$$

Based on that calculation, the length of the Hijri calendar in one year according to that formula is 354 days and 9 hours. So, when divided by seven days, it will leave four days and nine hours. However, if the number is more than 7 days, then 7 will be deducted with the aim that the result will not exceed 7. This is also strong evidence regarding the order of the letters of the year, where the formula is "remaining days and hours in the previous year plus 4 days and 9 hours. If the number of hours in the year is more than 24, then the year is a leap year.

- 2 days 6 hours (leave day from the Hindi letter of ب) + 4 days 9 hours = 6 days 15 Hours. in jumali counting, number 6 is the letter of و

- 6 days 15 hours + 4 days 9 hours = 10 days + 24 hours = 11 days 0 hours -7 days (due to more than seven days) = 4 days 0 hours. In the Hindi Letter, number 4 is the letter of د and this year is leap year.

- 4 days 0 hour + 4 days 9 hours = 8 days 9 hours -7 (due to more than seven days) = 1 days 9 hours. In the Hindi letter, number 1 is the letter of ا and this year is the leap year.

- 1 days 9 hours + 4 days 9 hours = 5 days 18 hours. In the Hindi letter, number 5 is the letter of هـ.

- 5 days 18 hours + 4 days 9 hours =10 days 27 hours = 10 days 3 hours -7 days (due to more than seven days) = 3 days 3 hours. In the Hindi letter, 3 is the letter of ج and this year is leap year.

- 3 days 3 hours + 4 days 9 hours = 7 days 12 hours. In the Hindi letter, number 7 is the letter of ز

- 7 days 12 hours + 4 days 9 hours = 11 days 21 hours -7 days (due to more than seven days) = 4 days 21 hours. In the Hindi letter, number 4 is the letter of د

- 4 days 21 hours + 4 days 9 hours = 8 days 30 hours =9 days 6 hours – 7 days (due to more than seven days) = 2 days 6 hours. In the Hinfi letter, 2 is the letter of ب and this year is leap year.

Therefore, the explanation of the arrangement of letters in the Aceh calendar will be:

No	Year Letter	Description	Jumali/Hindi
1	و	2+4 (years letter previously + days leave)	6
2	د	6+5 (years letter previously + days leave – 7 (because in one week there is 7 days))	4
3	ا	4+4-7 (previously year letter (year د end) + days leave – 7 (because in one week there is 7 days))	1
4	ه	1+4 (previously year letter + days leave)	5
5	ج	5+5-7 (previously year letter + days leave – 7 (because in one week there is 7 days))	3
6	ز	3+4 (previously year letter + days leave)	7
7	د	7+4-7 (previously year letter + days leave – 7 (because in one week there is 7 days))	4
8	ب	4+5-7 (previously year letter + days leave – 7 (because in one week there is 7 days))	2

Table 4. 3 Description of year letter of the Aceh Hijri calendar

The Aceh Hijri calendar has the months consisting of (زبجه وابده زاج). If this formula is studied using numbers, Hindi letters will become:

ذو الحجة	ذو القعدة	سوال	رمضان	شعبان	رجب	جماد أخر	جماد أول	ربيع آخر	ربيع أول	صفر	محرم
ج	ا	ز	ه	د	ب	ا	و	ه	ج	ب	ز
3	1	7	5	4	2	1	6	5	3	2	7

Table 4. 4 Name and letter of the month

From that table, it can be seen that, according to the Aceh Hijri calendar, each month has an excess of 1 or 2 days. This makes the arrangement of the letters of the month of the Aceh Hijri calendar become:

No	Name of The Month	Number of Days	Leave Days	Information	Jumali/Hindi
1	*Muharram (Asan Usen)*	30	2	The beginning month of Muharram is determined by the letter of the year	ر
2	*Shafar (Sapha)*	29	1	2+7-7 (remaining previous days + letters of previous month minus 7 (number of days in a week))	ب
3	*Rabiul Awal (Maulot Phon)*	30	2	1+2 (remaining previous days + previous month letters)	ج
4	*Rabiul Akhir (Maulot Teungoh)*	29	1	2+3 (remaining previous days + previous month letters)	ه
5	*Jumadil Awal (Maulot Akhe)*	30	2	1+5 (remaining previous days + previous month letters)	و
6	*Jumadil*	29	1	2+6-7 (remaining	ا

No	Name of The Month	Number of Days	Leave Days	Information	Jumali/Hindi
	Akhir (Khanduri Boh Kayee)			previous days + letters of previous month minus 7 (number of days in a week))	
7	*Rajab (Khanduri Apam)*	30	2	1+1 (remaining previous days + previous month letters)	ب
8	*Sya'ban (Khanduri Bu)*	29	1	2+2 (remaining previous days + previous month letters)	د
9	*Ramadhan (Puasaa)*	30	2	1+4 (remaining previous days + previous month letters)	هـ
10	*Syawal (Uroe Raya)*	29	1	2+5 (remaining previous days + previous month letters)	ز
11	*Dzulqa'dah (Meuapet/ Beurapet)*	30	2	1+7-7 (remaining previous days + letters of previous month minus 7 (number of days in a week))	ا
12	*Dzulhijjah (Haji)*	29/30	1 / 2	2+1 (remaining previous days + previous month letters)	ج

Table 4. 5 Algorithm of The Month Letter

B. Additional Formula of the Aceh Hijri Calendar

The Hijri calendar that we always use today relies heavily on the phases of the moon, known as the synodic moon phase. The highest synodic moon phase is 29.829761, or 29 days, 19 hours, 54 minutes, and 51.35 seconds, while the lowest synodic moon phase is 29.274360, or 29 days, 6 hours, 35 minutes, and 4.7 seconds.

This thesis compares the results of calculating the beginning of the Aceh Hijri calendar month with the beginning of the Hijri month using the Neo-Mabims criteria, starting from 1 Hijri year to 1500 Hijri years. Based on that year, when connected to the Now Mabims criteria, it will find that the average length of the synodic month is 29 days, 12 hours, 43 minutes, and 53 seconds. This shows a difference of 10 seconds with the average length of the synodic month, which has 29 days, 12 hours, 44 minutes, and 3 seconds. Based on this, the difference between the Aceh Hijri calendar and the average synodic month for Neo-Mabims is:

	Days	Hours	Minute	Second	Total (Decimal)
Long Aceh Month	29	12	45	0	29,53125
Long Neo Mabims	29	12	43	53	29,5305787
Defference	0	0	1	7	0,000671296

Table 4. 6 The difference between the length of the aceh month and the synodic month

This shows why the Aceh calendar cannot be reused. Apart from the Aceh calendar not having a correction formula, the Aceh calendar has a different algorithm of calculation than the Hijri calendar.

To unite the Aceh Hijri calendar with the Hijri calendar, an additional formula is needed. From the calculation above, it can be concluded that every year, Aceh experiences a difference of 11 seconds with the Hijirah calendar. So that every 125 years, the Aceh calendar must reduce 1 day so that it can match the Hijri calendar used today.

	Days	Hours	Minute	Second	Total (Decimal)
Long Aceh year	354	9	0	0	354,375
Long Mabims Year	354	8	46	36	354,3656944
Difference	0	0	13	24	0,009305556
Correction 108 years	1	0	7	12	1,005
Remainder	0	0	7	12	0,005

Table 4. 7 Annual correction of Aceh's Hijri calendar

From the table above, it can be concluded that the Aceh Hijri calendar has an excess of 13 minutes and 24 seconds each year. So that every 108 years, the Aceh Hijri calendar must reduce one day so that it can adjust to the Mabims Hijri calendar.

C. The Accuracy Level of the Aceh Hijri Calendar

In general, all Hijri calendars that use average calculations use a 120-year correction. Every 120 years, the Hijri calendar, which uses the

average calculation, must be reduced by one day to adjust to the Hijri calendar.

In this thesis, the correction used is 108 years. This is because this thesis adjusts the Aceh Hijri calendar to the Hijirah calendar using the new criteria from MABIMS.

Because of that, to prove the legitimacy of the Aceh Hijri calendar, this thesis compares the Aceh Hijri calendar (using 108-year and 120-year repetition corrections) with the Hijri calendar using Mabim's criteria as the main reference in the Hijri calendar system in Indonesia, especially starting from 1 Hijriah to 1500 Hijriah. Based on these data, this thesis concludes that:
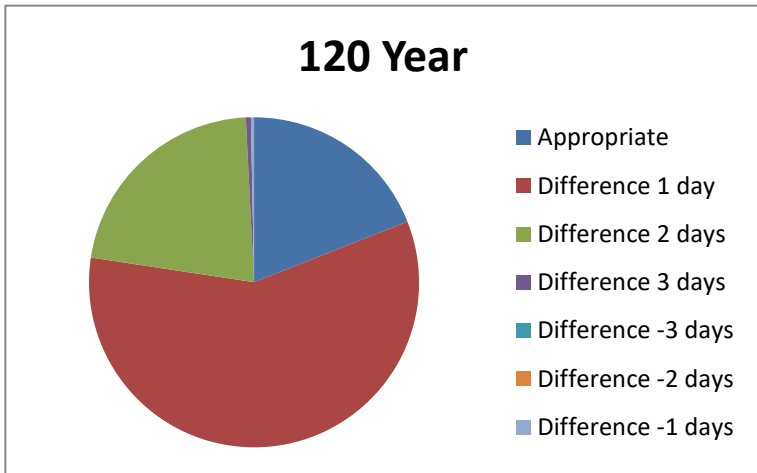
1. Repetition correction of 120 year

Year Correc tion	Appr opria te	Defference					
		1 day	2 days	3 days	-3 days	-2 days	-1 day
120 Years	3420	10509	3924	91	0	0	56
		19%	58%	22%	1%	0%	0%

Table 4. 8 Similarities and Differences of Aceh Hijri Calendar with the Neo Mabims Hijri Calendar with a 120-year cycle

Based on the table, it is clear that the repetition of 120 years results in the beginning of the month with a very large difference in one day, compared to the same day as the beginning of the Hijri

month according to the Neo Mabims calendar. For more details, consider the following image:
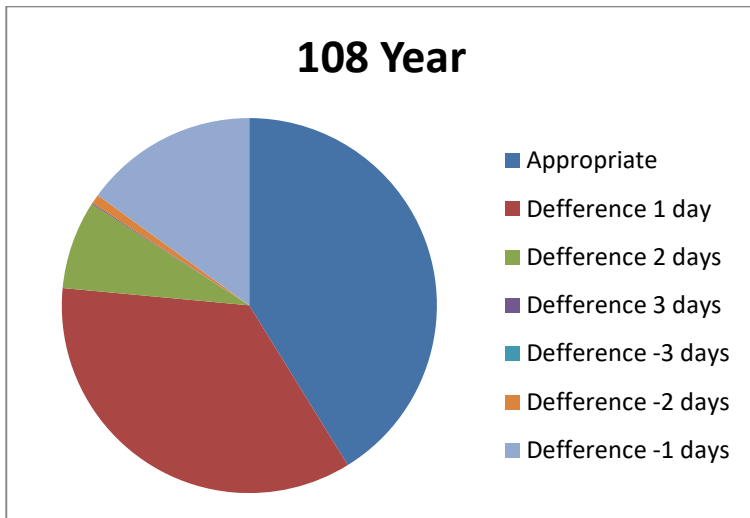

Picture 4. 1 Similarities and Differences of Aceh Hijri Calendar with the Neo Mabims Hijri Calendar with a 120-year cycle

2. Repetition correction of 108 year

Year Correction	Appropriate	Defference					
		1 day	2 days	3 days	-3 days	-2 days	-1 day
108 Years	7415	6353	1372	21	0	143	2696
	41%	35%	8%	0%	0%	1%	15%

Table 4. 9 Similarities and Differences of Aceh Hijri Calendar with the Neo Mabims Hijri Calendar with a 108-year cycle

Based on the table, it is clear that the repetition of 108 years results in a more suitable start of the Hijri month than the current start of the Hijri month, which is at odds with the Neo-Mabims Hijri calendar. This shows that cycle 108 in the Acehnese Hijri calendar can be more in accordance with the calculation of the beginning of the Hijri month according to the Neo-Mabims criteria. For more details, consider the following image:

Picture 4. 2 Similarities and Differences of Aceh Hijri Calendar with the Neo Mabims Hijri Calendar with a 108-year cycle

Thus, it can be concluded that the Aceh Hijri calendar can be calculated using the existing formula and adding correction formulas to adjust the Hijri calendar.

D. Example of Calculating the Aceh Hijri Calendar

This thesis calculates the beginning of the month of Shawwal in 1444 Hijriah based on the calculation of the beginning of the month in the Aceh Hijri calendar.

1. Calculating the Aceh hijri calendar cycle
   - Year 1444 / 108 = 13 cycles (yield) and 40 years (residual)
   - The result of 13, counting backwards from Saturday is Monday

2. Counting the letters of the year
   - 1444 / 8 = 180 (yield) and 4 (remainder)
   - The remainder of the division determines the letter of the year. This calculation starts with the letter و, so the number 4 denotes the letter of the year ه which in hindi/jumali calculations has the number 5.

3. Counting the letters of the month
   - The month of Shawwal coincides with the lunar letter ز which has the number 7 in Hindi/Jumali.

4. Determine the start of the day
   - Add the letters of the year and the letters of the month, 5 + 7 = 12. Then calculate the sum from Monday (because the year 1444 is in the 13th cycle).

- So the beginning of the month of Shawwal in 1444 Hijri coincided with Friday.

CHAPTER V

CLOSING

A. Conclusion

Based on the discussion that has been described in this thesis, conclusions can be drawn

1. The Aceh calendar has an age of 354 days 9 hours in one year, that it make the years letters أهجزدبود and the month will leave

   one or two days so that make the month letter زبجه وابده زاج

2. There is a difference in age between the Aceh Hijri calendar and the Hijri calendar of as much as 7 minutes and 12 seconds in one year. Every 108 years, the Aceh calendar must be reduced by 1 day in order to adjust to the Hijri calendar.

3. Based on the results of a comparison from 1 to 1500 Hijriah, the accuracy of calculating the Aceh calendar using a repetition of 108 years has similarities with the Neo-Mabims Hijri calendar of 7415 months, or 41% of the whole.

B. Sugestion

Based on the conclusions drawn as mentioned above, this thesis provides the following suggestions:

1. The new formula shows that the ACEH calendar can be reused using the new formula that this thesis has compiled.

2. An algorithmic approach to the Aceh Hijri calendar system uses the haqiqi taqribi algorithm. So there is a possibility that the latest algorithms are much more accurate.

3. Aceh's Hijiri calendar is only used as knowledge for understanding culture and the Hijri calendar. For important months (the month of Ramadan, such as Shawwal and Dzulhijjah), it still returns to the government's decision.

C. Closing

Alhamdulillah, all praise is due to Allah, and the writer is very grateful to Allah the Almighty, who has given strength, patience, and guidance to finish writing this undergraduate thesis. All the salawat and greetings will also be delivered to Prophet Muhammad SAW, with his words, actions, and taqrir as a complement and explanation of the word of God (the Qur'an). Which became a guide for the order of human life to achieve true happiness.

Although the author has tried her best, she realized there are still shortcomings in this research. It's far from perfection. That's why, with all her humility, the writer apologizes profusely to all parties related to this thing. So, the constructive criticism and suggestions are waiting for the progress of the better writing.

Finally, the writer hopes this thesis can be useful for society in general, especially for the writer and his family. Thank you very much

for all your attention and appreciation. May we always get forgiveness and guidance from Allah. *Wallahu a'lam.*

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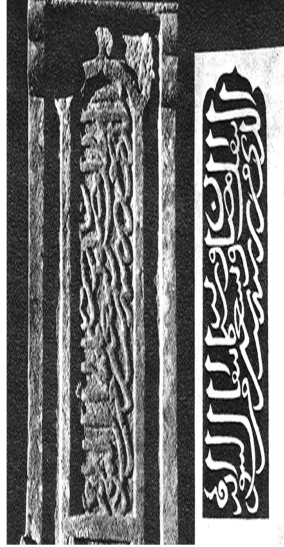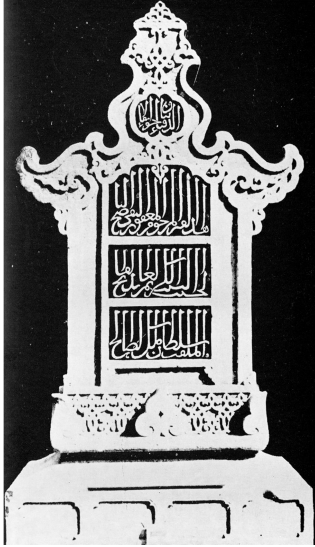———. *Kamus Ilmu Falak*. 1st ed. Jogjakarta: Buana Pustaka, 2005.

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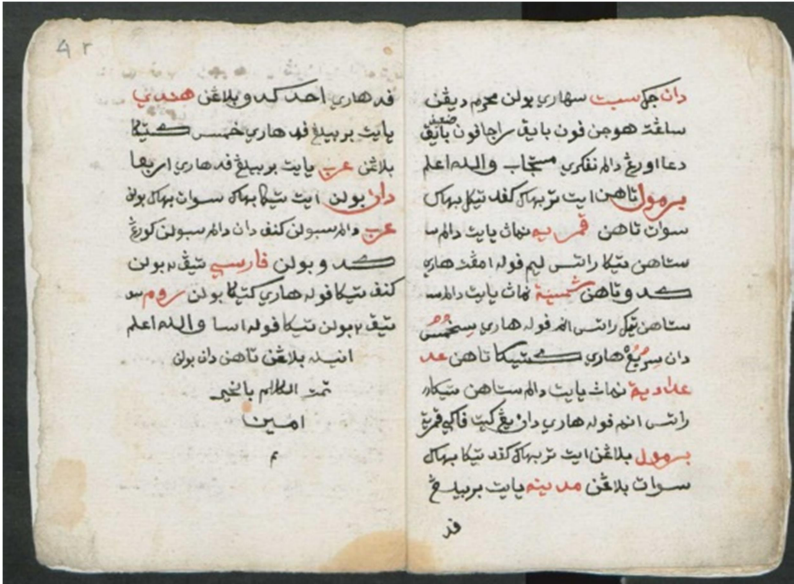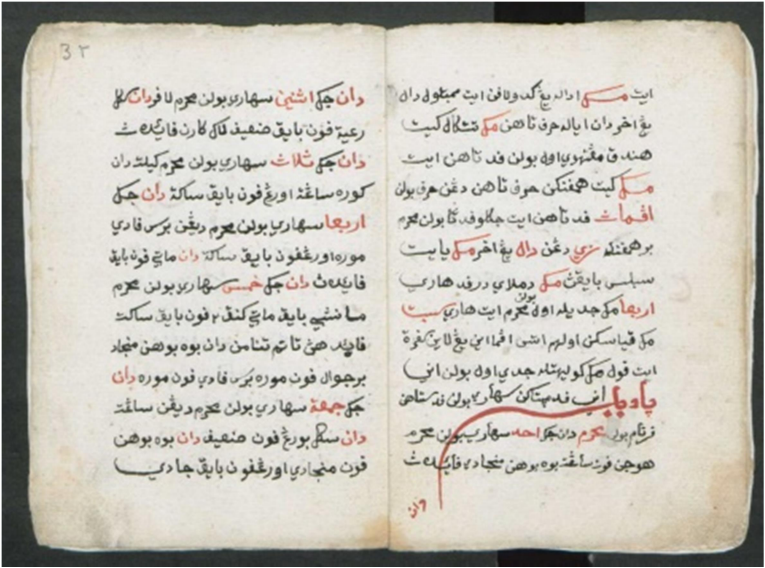
ATTACHMENTS

Attachment I: stone of Sultan Malik As-Saleh

Attachment II: Manuscript of *Risalah Asy-Syaikh 'Abd Ar-Rauf fi At-Taqwim*

٣٣

ايت مكى اداـبغ كدوبلافى ايت ممبتلوڽ دان
بؤ اخردان اباالدحرف تاهن مكى نتناك كبيت
هند فى مغتروباۏه بولن فد تاهن ايت
مكى كبت هڠتنان حرف تاهن دغن حرق بولن
اقماف فد تاهن ايت جكاوفد تا بولن مجرم
برهفنكو مرى دغن داـ بغ اخرو مكى بايت
سبلس بايغت مكى دملاـى درفد هارب
اربعا مكجد يلم اوـ مجرم ايت هارب سيت
مكى قياسكن اولم انتى اقماـبى بغ لا بغ غرة
ايت قوـ مكى كوليمتلم جد يا وه بولن انى
باوباب انب فدمهتاـى سهار ـبولن ند سناهن
فنتام بون مجرم دن جكا احمد سهار ـيوبون مجرم
هوجن فدساغد بوه بوهن منجاد ـفاـ بـه ـ

١٦

دان جكى اثنى سهار ـبولن مجرم لافون دان كلؤ
رعية فون بايق ضعيف كلاـ كارن فاـ يـ ـ
دان جك ثلاث سهار ـبولن مجرم كبتر دان
كوره ساغة اورغ فون بايق سكة دان جكى
اربعا سهار ـبولن مجرم ديغن برس فادى
موره اورغفون بايق سكة دان ماـ فؤن بايق
فايدث دان جك خمس سهار ـبولن مجرم
مان ششى بايق ماـ كنغ ـفون بايق سكت
فاـ يد هـ تا تم تنامن دان بوه بوهن مهاد
برجوان فون موره برس فادى فون موره دان
جك جمعة سهار ـبولن مجرم ديغن ساقمت
دان سكى بورغ فون ضعيف دان بوه بوهن
فون منجادى اورغفون بايق جهاد يـ ـ

٤٣

دان جك سيت سهار ـبولن مجرم ديغن
ساغت هومن فون بايق سراجالون ضعيف
دعااورغ داله نفكرن مسجاب واللـه اعلم
برمول اين ايت مـبرماـ كلفد نيكا بماـ
سولن تاهن قمـ يم نمات بايت داله سا
ستاهن نيكا راتس لىم فولد امغد هارـ
سكد وتاهن حميسـ نمات بايت داله سا
ستاهن نيكر راتس الم فولد هارـ سبغسى
دان سربغ هارـ سنيكا تاهن عد
علاد يـ نمات بايت داله ستاهن نيكا
راتس انم فولد هارـ داربغ كبت فاكه فرغ
برمول بلاغن ايت مـبرماـ كند نيكا بماـ
سوات بلاغن مد يم بايت بربيـ غ
فر

فدهارى احد كد وبلاغن هديـى
بايت بربيـ غ فه هارى خمس سنيكا
بلاغن عرب بايت بربيـ غ فدهارى اربعا
دارى بولن ايت سنيا بماك سوات بماك بولن
عرب والم سبولن كنف دان دالم سبولن كورغ
سكد و بولن فارسى شيغ وبولن
كنف نيكا فولد هارى كنيكا بولن رؤم سد
نيغ وبولن نيكا فولد ماسا واللـه اعلم
انيد بلاغن تاهن دان بولن
تمـ الكلام باغيى
اميـ
م

Attachment III: unlined table from Teuku Imum Lhok Kaju

Attachment IV: The average calculation date table according to Teuku Abu Chik Kutakarang

Attachment V: Hijri calendar comparison calculation using new criteria from MABIMS and the Aceh Hijri calendar using cycles of 120 years and 108 years from 1 to 1500 Hijriah

CURRICULUM VITAE

SELF QUALIFICATIONS

Name   : Wali Cosara

Place, Date of Birth   : Banda Aceh, October 24, 2000

Address   : K. Arahman Street, Ceurih Village, Ulee Kareng, Banda Aceh, Aceh

Contact Number   : +62 812 6965 2010

E-Mail   : walicosara1@gmail.com

ACADEMIC QUALIFICATION

A. FORMAL ACADEMICS

1) 56TH State Elementary School Banda Aceh (2006-2012)
2) Islam Darul'ulum Junior Boarding School (2012-2015)
3) Darul'ulum Islamic Senior Boarding School (2015-2018)
4) State Islamic University of Walisongo Semarang (2018-2021)
5) Postgraduate State Islamic Universityof Walisongo Semarang (2021-now)
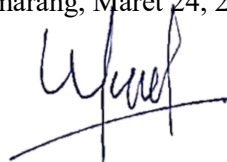
B. NON FORMAL ACADEMICS:

1) Darul'ulum Islamic Boarding School (2012-2018)
2) TOEFL Training from Language Development Center of Islamc State University of Walisongo Semarang (2019)
3) English language training program from BLK of Ministry of Labour (2022)
4) Interns at the Planetarium and Observatory Zuhal of State Islamic University of Walisongo Semarang (2022-now)

5) YPMI Al-Firdaus Islamic Boarding School (2018-now)

C. SCIENTIFIC PAPERS

1) Algoritma awal bulan dalam Manuskrip *Risalah Asy-Syaikh 'Abd Ar Rauf fi At-Taqwim* (Undergraduate Thesis)

2) Algoritma Awal Bulan Syiah Kuala (Journal)

3) Observatorium Pertama di Nusantara (Opinion)

Semarang, Maret 24, 2023

Wali Cosara
Student ID : 2102048022