The Tanaffas and Isfar Phases of the True Dawn

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Abstract—True dawn determines the beginning time of fair prayer. At the moment dawn rises, the intensity of the brightness is very low. The brightness of the dawn increases gradually until it is bright. The brightness of dawn increases in phases. The phase of dawn or fajr in the Qur'an is mentioned as tanaffas and isfar in surah At-Takwir verse 18 and Al-Mudatsir verse 34 respectively. These verses show that there are at least two types of brightness at dawn related to tanaffas and isfar. These two different brightness levels show there are two phases of true dawn. This study aimed to determine the time and the angle of the Sun for the tanaffas and isfar phases. This study was carried out by field observation method at locations in Malaysia and Indonesia. The instrument used was a thread window. The results showed that the tanaffas phase appeared when white thread was seen and the isfar phase happened when black thread was seen. The tanaffas phase occurred 14 minutes after true dawn rises at the angle of the sun 16 degrees below horizon meanwhile the isfar phase occurred 25 minutes after true dawn rises at angle of the sun 14 degrees below horizon until sunrise.

Keywords: True Dawn; Phase; Tanaffas; Isfar; Thread Window

Abstrak: Fajar sidik menjadi penentu awal waktu solat subuh. Keamatan kecerahan fajar sangat rendah ketika mula terbit. Kecerahan bertambah secara beransur-ansur fajar sehingga cerah. Kecerahan fajar bertambah secara berfasa. Fasa fajar atau subuh di dalam Al-Quran disebut sebagai tanaffas dan isfar dalam surah At-Takwir ayat 18 dan Al- Mudatsir ayat 34 masing-masing. Ayat ini menggambarkan ada dua peringkat atau fasa kecerahan waktu subuh iaitu tanaffas dan isfar. Dua peringkat kecerahan yang berbeza ini menggambarkan ada dua fasa fajar sidik. Penelitian ini bertujuan untuk menentukan waktu berlaku dan sudut tunduk Matahari untuk fasa tanaffas dan isfar. Penelitian dijalankan dengan kaedah cerapan di lapangan di beberapa lokasi di Malaysia dan Indonesia. Perkakasan yang digunakan ialah tetingkap benang. Dapatan menunjukkan fasa tanaffas apabila benang putih mula kelihatan dan fasa isfar apabila benang hitam mula kelihatan. Fasa tanaffas terjadi 14 minit selepas fajar sidik terbit pada sudut matahari 16 darjat di bawah ufuk sementara fasa isfar terjadi 25 minit selepas fajar sidik terbit pada sudut 14 darjat di bawah ufuk hingga terbit Matahari.

Kata kunci: Fajar Sidik; Fasa; Tanaffas; Isfar; Tetingkap Benang

I. INTRODUCTION

According to fiqh, true dawn is the sunlight that rises from the east and spreads to cover the horizon and then spreads up into the sky. True dawn is the light that appears after dawn and shows a reddish hue. It ends after the sun slowly rises over the eastern horizon [1]. From an astronomical point of view, dawn occurs due to the scattering of light by the atmosphere that surrounds the earth. The scattering of this light depends on the inclination angle of the Sun [2]. There is no light scattering effect when the angle of the sun is 18 degrees below the horizon [3].

True dawn is important in determining the time of morning prayer. The determination of the time of dawn depends on the angle of the Sun. True dawn can be seen rising on the eastern horizon when the Sun is at a certain angle below the horizon. Previous studies related to the calculation of the morning prayer time can be seen in the Middle Ages of Islamic Civilization and in the Malay world. For the calculation of dawn time, there are several angle values used by Islamic astronomers such as in King [4], Baharrudin [5], and Arwin [6].

Many astronomical figures from the 9th century to the 19th century (4th century Hijri to 13th century Hijri) have used several values of the angle of the sun to determine the time of dawn. Among the figures of Malay astronomer are Sheikh Muhammad Arsyad Al-Banjari, Sheikh Muhammad Ali Abdul Mutalib al-Minangkabawi, Sheikh Hassan Yahya Jambi, and Sheikh Jamil Jambek. In addition, there are several figures from Pattani such as Sheikh Ahmad bin Muhammad Zain Al-Fatani, Sheikh Abdul Rahman Muhammad Ali al-Fatani and Muhammad Salih Cambodia [7]. These figures are also scholars who show elements of progress and development in the aspect of science in the Malay world [8].

One of the characteristics of true dawn is that the brightness of the dawn starts dimly and gradually brightens until the sun rises. Dawn is the light that begins from the darkness and gradually changes to bright [9]. The duration of the true dawn starts from when it rises until it ends when the sun rises. As the dawn begins to appear or rise, the intensity of the dawn's brightness is very low. The intensity of the dawn's brightness increases gradually until it becomes bright. The gradual increase in brightness is called phases. In the Al-Quran there are verses that give an idea of the dawn phases. The verses related to the phases of dawn are And the day as it breaks. At-Takwir: 18 And by the morning when it brightens. Al-Mudatsir: 34

Hamka in his Al-Azhar book of interpretation, the word tanaffas in verse 18 of surah At-Takwir is translated as breathing [10]. These two verses show that there are two states of brightness at dawn, namely tanaffas and isfar. These two different levels of brightness are called phases of dawn. This study aims to determine when the tanaffas and isfar phases occur based on the brightness of dawn. This study also aims to find out the angle of the sun below horizon that causes the phase to occur.

When the dawn just rises, it was still dark because the intensity of the dawn light is still low. The vision of the eye in this condition is scotopic vision. The eye can only distinguish between black and white. This is as explained in Al-Quran verse 187. surah Al- Baqarah which means; Eat and drink until it is clear to you the white thread from the black thread.

From the verse above, outwardly signaling the dawn can be recognized or identified with the eyes so clearly as it is clear between the white thread and the black. In the verse the white thread is mentioned first then followed by the black thread. This signals the appearance of the white and black threads in sequence; the white thread being seen first then followed by the black thread. This verse also indicates that vision in the dark can only see white and black.

Changing from bright to dark conditions, the eyes will go through a period of dark adaptation, i.e., the eyes will adapt from a state of high brightness to low brightness. The adaptation period between rod and cone cells differs due to the recombination of photopigment to restore retinal sensitivity. It takes the eyes between 20-30 minutes to adjust from bright light to complete darkness. While from dark to light the eyes take only five minutes to adjust.

Therefore, this study aims to measure the extent of the scotopic view of the white and black threads during the appearance of true dawn. Dawn can be seen with the naked eye. The eye is a light- sensitive organ. The eye is a special organ gifted by Allah that can adjust in various light conditions. The eye has a light- sensitive layer called the retina. The retina, which is the innermost layer of the eye wall, is a thin and translucent structure. The retina contains light nerves and blood vessels. The layers of the retina that are sensitive to light are known as the rods and cones. Cone cells function for bright and color vision. Rod cells are responsible for vision in dim conditions. Rod cells do not respond to color, in fact there are no rod cells along the line of sight.

The operation of rod and cone cells depends on the brightness of the view. Brightness depends on the type of light, for example the brightness of the moonlight differs from that of the stars. Rod vision is called scotopic vision, while cone vision is called photopic vision [11]. Rod cells respond in dim or night conditions, while cone cells respond in light or day conditions. The region between the cone and the rod is called the mesopic vision. Brightness and its relationship with scotoptic, photopic and mesopic views as in Figure 2.



Figure 2. Scotopic, photopic and mesopic views

II. METTHOD

A. The thread window

This study aims to determine the time and angle of the sun for the tanaffas and isfar phases of true dawn based on observation using a thread window. The change in the intensity of the brightness of dawn light from dim to bright gradually so that the eye cannot distinguish small changes in brightness, especially in scotopic vision. Phases can be detected when there is a significant difference in dawn brightness. The tool used to detect the phase of dawn with the eye is the thread window. The thread window consists of white and black threads stretched inside an opaque paper box.

The thread window is a simple tool made from a 20 cm x 20 cm x 3 cm hard paper box. This device consists of white and black thread stretched inside an opaque paper box. The box is closed on each side and the bottom of the box but the top of the box is open. The inside of the box consists of several strands of ordinary black and white thread. Each piece of black and white thread is tied tightly in parallel in the middle of the box as in Figure 1. To ensure that only dawn light and no other light reaches the thread window, barriers are attached to the left and right of the thread window.



Figure 1. Thread window

Black and white threads are used in this study based on verse 187 of surah Al-Baqarah in the Al-Quran. Black and white threads are used to match the scotopic view. In scotopic vision the eye can only distinguish between black and white. The eye cannot recognize colored objects in scotopic vision [12]. In scotopic vision, the eye begins to see when the brightness of the light is at the threshold of vision. In the tanaffas phase, the eyes cannot recognize colors. Thus, the tanaffas phase occurs in scotopic vision. While in the asfar phase, the eye begins to recognize colors and can distinguish objects seen. Thus, the isfar phase occurs in the photopic view.

B The steps of data collection

i. A number of volunteer observers consisting of two to five people are involved in this study. The observers involved have good eye sight.

ii. Observations begin between 20 and 30 minutes before dawn. Observation is done at a site where there is no light such as moonlight, street lights or light pollution from nearby areas.

iii. The eastern horizon where the sun rise is ensured that not to have any light like a lighthouse.

iv. The eastern horizon is ensured that there are no thick clouds until the altitude exceeds 8 degrees from the horizon. Thick clouds can block the dim light of dawn.

v. The observer looks at the thread by holding the open part of the thread window.

vi. The observer turns his back to the horizon while holding the thread window. The position of the thread window is raised slightly above of the observer's head as in Figure 3.

vii. The observers observes the black and white thread in the thread window every minute. The observer records the time when the thread starts to be visible as either a black or white thread.

viii. The study also determined the angle of the sun below the horizon when the white thread and the black thread first appeared.

To find out the angle of the sun below the horizon, an astronomical application is used, namely Sun Surveyor. In addition, calculation methods with certain mathematical formulas are also used. The study was carried out in several locations in the states of Kelantan, Terengganu and Pahang in Malaysia. While in Indonesia in Aceh and South Sulawesi.

The criteria for the selected location are a location facing the eastern horizon, no obstacles and no light disturbances such as light pollution. The location faces east because the dawn begins to appear where the Sun rises on the eastern horizon.

The location of the study is an area far from the city and there is no light disturbance. Data containing many disturbances such as lightning, light reflection from clouds, rain, and thick cloud cover on the horizon are removed.

Observations start 30 minutes before the local morning prayer time (adhan time) according to the prayer time table issued by the religious authorities of Malaysia and Indonesia

This study was conducted on a date when there was no moonlight because moonlight can also interfere with the observation results. For that purpose, this study was conducted before the full moon or the end of the month according to the Hijri calendar.

III. RESULT AND DISCUSSION

Table 1 shows the observation results according to the date and location of observation. This table shows the time of dawn, the time when the white thread and the black thread are visible.

Date	Location	Subh	White thread seen	Black thread seen
4/4/17	Kuantan,	5:55	6:13	6:29
2/5/17	Pekan, Pahang	5:39	5:58	6:08
3/5/17	Pekan Pahang	5:39	5:57	6:10
4/5/17	Pekan, Pahang	5:39	5:53	6:11
5/5/17	Pekan, Pahang	5:39	5:53	6:02

6/5/17	Pekan,	5:39	5:55	6:15
7/5//17	Pahang Pekan,	5:39	5:50	6:04
1/6/17	Pahang Pekan,	5:39	5:45	5:48
3/6/17	Pahang Pekan.	5:35	5:46	6:00
A/6/17	Pahang	5.35	5:45	6:00
4/0/17	Pahang	5.35	5.47	0.00
5/0/17	Pekan, Pahang	5:55	5:47	6:10
3/7/17	Pekan, Pahang	5:37	5:59	6:11
4/7/17	Pekan, Pahang	5:38	6:00	6:12
5/7/17	Pekan, Pahang	5:39	5:58	6:05
6/7/17	Pekan,	5:38	5:50	6:02
7/7/17	Panang Pekan,	5:38	5:54	6:10
24/7/17	Pahang Pekan,	5:44	6:00	6:08
25/7/17	Pahang Pekan,	5:44	5:56	6:05
26/7/17	Pahang Pekan	5.44	5:56	6.06
31/7/17	Pahang	5.44	5.56	6:05
1/9/17	T'gnu	5.44	5.56	6.06
1/0/17	T'gnu	5:44	5.50	0:00
2/8/17	Dungun, T'gnu	5:45	5:56	6:06
5/8/17	Dungun, T'gnu	5:45	5:55	6:06
23/10/1	Penarik, T'ganu	5:23	5:56	6:06
24/10/1	Penarik,	5:24	5:56	6:00
25/10/1	Bachok,	5:25	5:54	6:06
26/10/1	Bachok,	5:25	5:52	5:58
27/10/1	Bachok,	5:35	5:52	6:06
28/10/1	Bachok,	5:40	5:56	6:11
20/12/1	K'tan Sabang	5:20	5:40	5:41
7 21/12/1	Acheh, Sabang	5:21	5:32	5:40
7 23/12/1	Acheh, Sabang	5:21	5:34	5:48
7 25/12/1	Acheh, Sabang	5.22	5.33	5:37
7	Acheh,	5.22	5.24	5.20
20/12/1 7	Acheh,	5.25	5.34	5.39
27/12/1 7	Sabang Acheh,	5:23	5:33	5:43
28/12/1 7	Sabang Acheh,	5:25	5:33	5:39
29/12/1 7	Sabang Acheh.	5:25	5:33	5:44
27/3/18	Bira	4:44	4:51	5:01
28/3/18	Bira Sulawesi	4:47	4:55	5:01
29/3/18	Bira Sulawesi	4:47	4:54	5:00

Table 2 shows the time difference between dawn and the time when the white and black threads start to appear, as well as the angle of the sun below the horizon when the white and black threads start to appear.

Table 2.	Time di	ifference	and .	sun d	angle .	for	white
and blac	k threa						

Date	White after white (mins)	Black after subh (mins)	Sun angle, white thread (Deg)	Sun angle, black thread (Deg)
4/4/17	18	34	13.00	9.00
2/5/17	19	29	14.25	11.75
3/5/17	18	32	14.50	11.25
4/5/17	14	32	15.25	10.75
5/5/17	14	23	15.25	13.00
6/5/17	16	36	14.75	9.75
7/5//17	11	25	16.00	12.50
1/6/17	06	09	17.25	16.50
3/6/17	11	25	17.00	13.50
4/6/17	10	25	17.25	13.59
5/6/17	12	35	16.75	11.00
3/7/17	22	34	15.25	12.25
4/7/17	22	34	15.00	12.00
5/7/17	19	26	15.50	13.75
6/7/17	12	24	17.50	14.50
7/7/17	16	32	16.50	12.50
24/7/17	16	24	15.75	13.75
25/7/17	12	21	16.75	14.50
26/7/17	12	22	16.75	14.25
31/7/17	12	21	16.50	14.25
1/8/17	12	22	16.50	14.00
2/8/17	11	21	16.50	14.00
5/8/17	10	21	16.50	14.00
23/10/17	33	43	14.50	12.00
24/10/17	32	36	14.50	13.50
25/10/17	29	41	15.0	12.00
26/10/17	27	33	15.50	14.00
27/10/17	17	31	15.50	12.00
28/10/17	16	31	14.50	10.75
20/12/17	20	21	15.75	15.50
21/12/17	11	19	17.75	15.75
23/12/17	13	27	17.50	14.00
25/12/17	11	15	17.75	16.75
26/12/17	11	16	18.00	16.75
27/12/17	10	20	18.25	15.75
28/12/17	08	14	18.50	17.00
29/12/17	08	19	18.50	15.75
27/3/18	07	17	17.50	15.00
28/3/18	08	14	16.50	15.00
29/3/18	07	13	16.75	15.25
Average	14	25	16.21	13.57

The time recorded is the earliest time the white and black threads start to appear although the number of threads in the thread window cannot be determined yet. From the findings of the study, the time difference for the white thread is between 7 and 22 minutes. While the time difference for the black thread is between 13 to 37 minutes. The varying time difference between successive dates is dut to weather conditions on the horizon that change with the day before or after it. Weather changes on the horizon that usually affect the time of dawn are cloud patches, water vapor and fog. In this way, an average value is calculated from all 40

days of observation. Obtained the average time difference for the white thread and the black thread that can be observed is 14 minutes and 25 minutes respectively as in Table 2.

Findings show that the white thread starts to appear when the sun is below the horizon at an angle between 13 degrees and 18 degrees. While for the black thread, when the sun is at an angle between 9 degrees to 17 degrees as in Table 2. The findings show that the white thread can be seen after the presence of dawn light when the angle of the sun is at average angle of 16 degrees below the horizon while the black thread can be seen when the angle of the sun is at average angle of 14 degrees below the horizon.

The white thread begins to appear when the sun is at an average angle of 16 degrees below the horizon and the sky is still dark, this condition is called tanaffas phase. While the black thread begins to appear when the sun at an average angle of 14 degrees below the horizon begins to lighten, this condition is called the isfar phase.

During the tanaffas phase the sky is still dark and the stars can still be seen while in the isfar phase the reddish dawn light becomes clearer, the sky is brighter, the stars that can be seen are decreasing and the horizon can also be seen as in Figure 3.



Figure 3. The tanaffas (above) and the isfar (below) phases



Figure 4. The tanaffas and isfar phases

Figure 4 shows the dawn photos arranged in a row starting from dawn until sunrise. This picture shows the brightness range of the *tanaffas* phase starting from dawn until dawn begins to brighten. While the range of the *isfar* phase starts from the brighten of dawn until sunrise. In the *tanaffas* phase, the dawn light is very dim when the dawn starts to rise and gradually brightens while for the *isfar* phase, the intensity of the dawn light gets brighter until the sun rises.

CONCLUSION

True dawn consists of the tanaffas phase and the isfar phase. The tanaffas phase occurs in scotopic vision, which is a vision that recognizes black and white. White threads can be recognized earlier than black threads. While the isfar phase occurs in mesotopic vision with the eyes to recognize colors starting and distinguish objects seen. However, there is overlap between the tanffas and isfar phases there is no clear boundary between the two phases.

The tanaffas phase when the white thread starts to be visible, which is when the sun is between 14 degrees to 16 degrees below the horizon. While the isfar phase when the black thread starts to be seen, which is when the sun is between 14 degrees below the horizon until sunrise.

Findings from this study have contributed knowledge in understanding the meaning of the words tanaffas and isfar in verse 18 of surah at-Takwir and verse 34 of surah Mudatsir respectively.

The results of this study show that the white thread can be seen first before the black thread when the dawn begins to appear. This finding coincides with the meaning of verse 187 of Surah Al-Baqarah in the Al-Quran which mentions the white thread first and then the black thread "... until it is clear to you that the white thread is from the black thread which is the dawn.".

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