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Determination of Consumers' Awareness of the Health effects of Fruits Ripened with Calcium Carbide among House-holds in Rural and Urban communities in Jigawa State, Nigeria

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Abstract

The study was conducted using a survey design, employing a multi-stage sampling approach that combined purposive, random, and accidental sampling techniques. Three local government areas in Jigawa State, Nigeria, were selected and classified as urban, with one rural community chosen from each. A total of 150 participants, fifty (50) from each local government area, evenly split between urban and rural households were surveyed using a structured questionnaire to assess their awareness of the health risks associated with consuming fruits ripened with calcium carbide. The survey was conducted between November 4 and December 17 of the year 2024. Findings revealed that urban households had greater awareness of these health risks and a stronger ability to detect calcium carbide-ripened fruits compared to rural households. Similarly, individuals with tertiary education exhibited higher awareness and detection skills than those with lower education levels. Middle-aged participants also demonstrated greater awareness and detection capacity than older age groups. Public awareness needs to be strengthened among both rural and urban households through educational campaigns on radio, television, and other communication platforms about the risks of consuming fruit ripened with calcium carbide.

Keywords: House-hold, Awareness of Health risk, Calcium carbide-ripened fruits

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Introduction

The use of calcium carbide (CaC_2) to ripen fruits has become a widespread practice in many developing countries. It is one of the most commonly used and inexpensive chemicals for ripening fruits such as mangoes, bananas, guavas, papayas, apples, melons, and others (Lawaly, 2022). The natural ripening process involves a series of chemical changes that make the fruit sweeter, more flavorful, colorful, softer, and tastier (Osakue & Okungbowa, 2018). However, in recent times, this process has been artificially accelerated to meet the growing demand for ripe fruits, leading many fruit sellers, marketers, and farmers in developing countries, including Nigeria, to use chemicals like calcium carbide for ripening (Osakue & Okungbowa, 2018).

Calcium carbide, primarily used for welding (Adeyemi, Bawa & Muktar, 2018), has the unique property of reacting with water to release acetylene gas. This chemical compound is also used in the production of acetylene and calcium cyanamide. When applied to fruits, calcium carbide can induce ripening within 24 hours (Ismail et al., 2017). Numerous studies have revealed the potential risks of consuming fruits ripened with calcium carbide (Orok et al., 2024; Akinmoladun et al., 2020), as it contains impurities such as arsenic and phosphorus, which are toxic to human health. These substances are known to cause a range of health risks, such as skin irritation, gastrointestinal problems, and, in severe cases, cancer (Akinmoladun et al., 2020; Sharma & Sharma, 2021; Orok et al., 2024). It has been reported that the use of calcium carbide for fruit ripening significantly increases the risk of developing cancer, kidney, and heart diseases (Bature, 2018). Additionally, Hossain, Akhtar, and Anwar (2015) found that food commodities are often contaminated with toxic and hazardous chemicals like calcium carbide and ethylene, which are commonly used for fruit ripening.

Studies have also shown that using calcium carbide to ripen fruits can lead to a reduction in some nutrients (Adeyemi, Bawa & Muktar, 2018) and that it only changes the skin color of the fruit while leaving the inside raw (Chandle, 2014). Unfortunately, this artificial ripening process may diminish the health benefits of fruits, potentially compromising their role in disease prevention and overall nutrition (Osakue & Okungbowa, 2018).

The use of calcium carbide for ripening fruits has been banned in many developed countries due to its harmful effects (Ogbuagu, Ujowundu & Izunobi, 2016). However, this practice remains a major concern in developing countries, including Nigeria, which highlights the need for further investigation. Moreover, health issues such as kidney, liver, and cardiac diseases have become more prevalent today than in previous years. The study seeks to answer the following research question: Are household fruit consumers aware of the health effects of consuming fruits ripened with calcium carbide?

Methodology

The study was conducted using a survey design. A multi-stage process incorporating purposive, random, and accidental sampling techniques was adopted to engage participating households. Three (3) local government areas were selected and classified as urban. From each local government area, one rural community was also selected. A total of 150 participants were drawn, with 50 individuals from each local government area,twenty-five (25) from urban households and 25 from rural households in Jigawa. State, Nigeria. Participants were interviewed using a structured questionnaire to assess their awareness of the health effects associated with consuming fruits ripened with calcium carbide. The survey was conducted between November 4th and December 17th of the year 2024.

Result

Table 1: Demographic information of the participants

	Variable	Frequency	%
Gender	Male		
Age	19-27 years	14	9.65
	28-34 years	18	12.41
	35-41 years	37	25.52
	42-48 years	20	13.79
	49-55 years	31	21.38
	56-62 years	12	8.28
	63-69 years	11	7.57
	70-76 years	2	1.38
Educational Status			
	Non formal school	21	14.48
	Primary	16	11.03
	Secondary	44	30.34
	Tertiary	64	44.14

The table reveals that all household heads were male. A significant proportion (25.52%) were between the ages of 35 and 41, followed by those aged 49 to 55 (21.38%). Twenty individuals (13.79%) fell within the 42 to 48 age range, while the smallest group comprised those aged 70 to 76. Regarding education levels, the majority (44.14%) had attained tertiary education, followed by those with secondary education (30.34%). Additionally, 14.48% had no formal education, while the smallest group (11.03%) had only primary education. Overall, the table indicates that most household heads are in their younger years and have achieved a higher level of education, with only a few having completed primary schooling.

Table 2: Influence of Consumers' Location on the Awareness of the Health effects of Fruit Ripped with Calcium Carbide

(N=145)	**Urban**(n=80)				**Rural**(n=65)			
	Yes	%	NO	%	Yes	%	No	%
Cause lack of sleep, headache and dizziness	62	42.7	18	12.4	44	30.3	21	14.5
Consumption of fruit ripened with Calcium carbide can cause stomach upset	51	35.1	29	20.0	44	30.3	21	14.5
Cause skin disease	36	24.8	44	30.3	30	20.7	35	24.1
Consumption of fruits ripened with calcium carbide can cause cough and chest tightness	49	33.7	31	21.4	34	23.4	31	21.3
Consumption of fruit ripened with calcium carbide can cause lung failure	54	37.2	26	17.9	46	31.7	19	13.1
Consumption of fruit ripened with calcium carbide cause heart disease	55	37.9	25	17.2	41	28.3	24	16.6
Consumption of fruit ripened with calcium carbide can cause kidney problem	68	46.8	12	8.3	52	35.8	13	8.9
Consumptions of fruit ripened with calcium carbide result in high risk for developing cancer	54	37.2	26	17.9	48	33.1	17	11.7

The table shows that consumers in urban areas had a higher level of awareness (42.7%) that consuming fruits ripened with calcium carbide can cause insomnia, headaches, and dizziness. Similarly, urban participants demonstrated greater awareness (24.8%) than rural participants (20.7%) regarding the risk of skin diseases. Additionally, awareness of the potential for cough and chest tightness due to calcium carbide-ripened fruits was higher among urban consumers (33.7%) compared to their rural counterparts (23.4%). Urban consumers also exhibited greater awareness (37.2%) than rural consumers (31.7%) about the risk of lung failure from consuming such fruits. Likewise, more urban consumers (37.9%) were aware of the potential for heart disease compared to rural consumers (28.3%). Similarly, urban participants had a higher awareness (46.8%) than rural participants (35.8%) of the risk of kidney problems. Furthermore, urban consumers (37.2%) were more aware than rural consumers (33.1%) that consuming fruits ripened with calcium carbide may increase the risk of developing cancer. However, rural participants (44%) had greater awareness than urban participants (35.1%) regarding the risk of stomach upset. Overall, the table indicates that consumers' location influences their awareness of the health risks associated with consuming fruits ripened with calcium carbide. Specifically, urban consumers tend to have a higher level of awareness compared to those in rural areas."

Table 3: Influence of Consumers' Location on Detection of Fruit Ripen with Calcium Carbide

	Urban				**Rural**			
	Yes	%	NO	%	Yes	%	No	%
Fruits ripened with calcium carbide after few days have dots and patches on their surface	42	28.9	38	26.2	31	21.3	34	23.4
Fruits ripened with calcium carbide appear ripen and attractive in it outer surface while the inside remains green and raw.	58	40.0	22	15.2	49	33.7	16	11.0
Fruits ripened with calcium carbide may not be as tasty as naturally ripened fruits.	44	30.3	36	24.8	44	30.3	21	14.5
Fruits ripened with calcium carbide do not last long before getting spoilt compared to naturally ripened fruits.	57	39.3	23	15.9	55	37.7	10	6.9

Regarding the detection of fruits ripened with calcium carbide, urban participants exhibited a higher level of awareness (28.9%) compared to rural participants (21.3%). They were more likely to recognize that fruits ripened with calcium carbide develop dots and patches on their surface after a few days. Similarly, urban participants had a greater awareness (40.0%) than rural participants (33.7%) of the fact that such fruits may appear ripe and attractive on the outside while remaining green and raw inside. Additionally, urban participants (39.3%) were more aware than rural participants (37.7%) that fruits ripened with calcium carbide spoil more quickly compared to naturally ripened fruits. However, there was no difference in awareness between urban and rural participants (both at 30.3%) regarding the notion that fruits ripened with calcium carbide may not be as tasty as naturally ripened ones. The data suggests that consumers' location influences their ability to detect fruits ripened with calcium carbide. Overall, urban consumers demonstrate a greater ability to identify such fruits compared to their rural counterparts.

Table 4: Influence of Consumers' Educational background on Awareness of the Health Effects of Consumption of Fruits ripen with Calcium Carbide

	TER(n=67)				**SEC**(n=44)				**PRI**(n=13)				**NFS**(n=21)			
	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%
Fruit ripened with Calcium carbide can cause lack of sleep, headache and dizziness	56	83.6	11	16.4	23	52..3	21	47.7	3	23.1	10	76.9	04	19.0	17	80.9
Consumption of fruit ripened with Calcium carbide can cause stomach upset	57	85.1	10	14.9	32	72.3	12	27.3	03	23.1	10	78.9	03	14.3	18	85.7
Consumption of fruits ripened with calcium carbide can cause skin disease	45	67.1	22	32.8	19	43.2	25	56.8	02	15.4	11	84.6	00	0.0	21	100
Fruits ripened with calcium carbide can cause cough and chest tightness.	52	77.6	15	22.4	19	43.2	25	56.8	06	46.2	07	53.4	06	28.6	15	71.4
Consumption of fruit ripened with Calcium carbide can cause lung failure	55	82.1	12	17.9	32	72.2	12	27.3	07	53.8	06	46.1	05	23.8	16	76.2
Consumption of fruit ripened with calcium carbide cause heart disease	56	83.6	11	16.4	33	75.0	11	25.0	04	30.8	09	69.2	06	.28.6	15	71.4
Consumption of fruit ripened with calcium carbide can cause kidney problem	60	89.6	07	10.4	37	84.1	07	15.9	09	69.2	04	30.8	07	33.3	14	66.6
Fruit ripened with calcium carbide result in high risk for developing cancer	56	83.6	11	16.4	33	75.0	11	25.0	03	23.1	10	76.9	04	19.0	16	80.9

The table shows that consumers with tertiary education had the highest level of awareness (83.6%) regarding the health risks associated with consuming fruits ripened with calcium carbide, specifically its potential to cause insomnia, headaches, and dizziness. This was followed by those with secondary education (52.3%), while those with no formal schooling had the lowest awareness (19.0%). Similarly, awareness of the risk of stomach upset was highest among consumers with tertiary education (85.1%), followed by those with secondary education (72.3%), with the lowest awareness among those with no formal schooling (14.3%). Regarding the potential for calcium carbide-ripened fruits to cause skin diseases, awareness was again highest among tertiary-educated participants (67.1%), followed by those with secondary education (43.2%), while no awareness was recorded among those without formal schooling (0%). In terms of respiratory issues, 77.6% of tertiary-educated participants were aware that consuming such fruits could lead to coughing and chest tightness, compared to 43.2% of those with secondary education and 28.6% of those without formal schooling. Awareness of the potential for lung failure was also highest among tertiary-educated participants (82.1%), followed by those with secondary education (72.2%), while awareness was lowest among those with no formal schooling (23.8%). Similarly, awareness of the link between calcium carbide-ripened fruits and heart disease was highest among those with tertiary education (83.6%), followed by those with secondary education (75.0%), while the lowest awareness was recorded among those with no formal schooling (28.6%). Moreover, consumers with higher education had the greatest awareness (89.6%) of the potential for such fruits to cause kidney problems, followed by those with secondary education (84.1%), with the lowest awareness among those with no formal education (33.3%). Regarding the risk of cancer, awareness was highest among tertiary-educated participants (83.6%), followed by those with secondary education (75.0%), while the lowest awareness was found among those without formal schooling (19.0%). These findings indicate that consumers' educational background significantly influences their awareness of the health risks associated with consuming fruits ripened with calcium carbide. Overall, households with tertiary education levels demonstrate a higher awareness of these risks compared to those with lower levels of education.

Table 5: Influence of Consumers' Educational Background on Detection of Fruits Ripened with Calcium Carbide

	TER(n=67)				**SEC** (n=44)				**PRI (**n=13)				**NFS** (n=21)			
	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%	Yes	%	No	%
After few days have dots and patches on their surfaces	39	58.2	33	49.3	18	40.9	26	59.1	04	30.7	09	69.2	03	14.3	18	85.7
Appear ripe and attractive in its outer surface while the inside remains green and raw	49	73.1	18	26.9	26	59.1	18	40.9	01	7.6	12	92.3	01	4.8	20	95.2
May not be as tasty as naturally ripened fruits.	53	79.1	14	20.9	24	54.5	20	45.5	04	30.8	09	69.2	07	33.3	14	66.7
Do not last long before getting spoilt compared to naturally ripened fruits	59	88.1	08	11.9	34	77.3	10	22.7	04	30.8	09	69.2	12	57.1	09	42.9

The table shows that consumers with tertiary education had the highest level of awareness (58.2%) regarding the detection of fruits ripened with calcium carbide, recognizing that such fruits develop dots and patches on their surface after a few days. This was followed by those with secondary education (40.9%), while the lowest awareness was observed among those with no formal education (14.3%). Similarly, the ability to detect that fruits ripened with calcium carbide may appear ripe and attractive on the outside while remaining green and raw inside was highest among participants with tertiary education (73.1%), followed by those with secondary education (59.1%), with the lowest awareness among those with no formal schooling (4.8%). Consumers with higher education also had the greatest awareness (79.1%) that fruits ripened with calcium carbide may not be as tasty as naturally ripened ones. This was followed by those with secondary education (54.5%), while the lowest awareness was recorded among those with primary education (30.8%). Regarding the ability to detect that fruits ripened with calcium carbide spoil more quickly than naturally ripened ones, participants with tertiary education had the highest awareness (88.1%), followed by those with secondary education (77.3%), with the lowest awareness among those with primary education (30.8%). The table indicates that consumers' educational background influences their ability to detect fruits ripened with calcium carbide. Overall, it reveals that households with tertiary education levels are better able to identify such fruits compared to those with lower education levels.

Table 6: Influence of Age range of Consumers' on Awareness of the Health Effects of Fruits ripen with Calcium Carbide

	Age															
	19-27 n-14		28-34 n-18		35-41 n-37		42-48 n-20		49-55 n-31		56-62 n-12		63-69 n-11		70-76 n-2	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Cause lack of sleep, headache and dizziness	12 8.3%	2	10 6.8%	8	25 17.2%	12	14 9.6%	6	25 17.2%	6	8 5.5%	4	9 6.2%	2	2 1.4%	0
Cause stomach upset	6 4.1%	8	7 4.8%	11	27 18.6%	10	15 10.3%	5	21 14.5%	10	8 5.5%	4	9 6.2%	2	2 1.4	0
cause skin disease	4 2.7%	10	3 2.1%	15	19 13.3%	18	8 5.5%	12	17 11.7%	14	5 3.4%	7	9 5.2%	2	0 0%	2
Cause cough and chest tightness.	7 4.8%	7	5 3.4%	13	24 16.6%	13	12 8,2%s	8	20 13.8%	11	6 4.1%	6	10 6.9%	1	1 0.7%	1
Cause lung failure	3 2.1%	11	9 6.2%	9	31 21.4%	6	12 8.3%	8	25 17.2%	6	8 5.5%	4	9 5.2%	2	2 1.4%	0
Cause heart disease	6 4.1%	8	9 6.2%	9	31 21.4%	6	11 7.6%	9	26 17.9%	4	8 5.5%	4	9 5.2%	2	2 1.4%	0
Cause kidney problem	10 6.7%	4	14 9.7%	4	34 23.4%	3	14 9.7%	6	26 17.9%	4	9 6.2%	3	11 7.6%	0	2 1.4%	0
High risk for developing cancer	4 2.8%	10	9 6.2%	9	30 20.7%	7	13 8.9%	7	23 15.9%	8	11 7.6%	1	10 6.9%	1	2 1.4%	0

The results indicate that consumers aged 35 to 41 years and 49 to 55 years had the highest awareness (17.2%) that consuming fruits ripened with calcium carbide can cause insomnia, headaches, and dizziness compared to other age groups. Consumers aged 35 to 41 years also had the greatest awareness (18.6%) that consuming such fruits can lead to stomach upset, followed by those aged 49 to 55 years (14.5%), with lower awareness among other age groups. Similarly, awareness of the link between calcium carbide-ripened fruits and skin diseases was highest among consumers aged 35 to 41 years (13.3%), followed by those aged 49 to 55 years (11.7%). Regarding respiratory issues, consumers aged 35 to 41 years had the highest awareness (16.6%) that these fruits can cause coughing and chest tightness, followed by those aged 49 to 55 years (13.8%). Awareness of the risk of lung failure due to the consumption of calcium carbide-ripened fruits was also highest among those aged 35 to 41 years (21.4%), followed by those aged 49 to 55 years (17.2%). Similarly, awareness of the potential link between these fruits and heart disease was greater among consumers aged 35 to 41 years (21.4%), followed by those aged 49 to 55 years (17.9%). In addition, consumers aged

35 to 41 years demonstrated the highest awareness (23.4%) that consuming such fruits can cause kidney problems, followed by those aged 49 to 55 years (17.9%). Awareness of the risk of developing cancer due to the consumption of calcium carbide-ripened fruits was also highest among those aged 35 to 41 years (20.7%), followed by those aged 49 to 55 years (15.9%). These findings suggest that age influences consumers' awareness of the health risks associated with consuming fruits ripened with calcium carbide. Overall, the table demonstrates that households within the 35 to 41 age range exhibit the highest level of awareness regarding these health effects.

Table 7: Influence of Age range of Consumers' on Detection of Fruit Ripen with Calcium Carbide

	Age															
	19-27 n-14		28-34 n-18		35-41 n-37		42-48 n-20		49-55 n-31		56-62 n-12		63-69 n-11		70-76 n-2	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Have dots and patches on their surface	6 4.1%	8	8 5.5%	10	19 13.1%	18	7 4.8%	13	14 9.6%	17	9 6.2%	3	9 6.2%	2	0%	0
Appear ripe and attractive in its outer surface while the inside remains green and raw.	14 9.7%	0	13 8.9%	5	20 13.8%	17	16 11.0%	4	24 16.6%	7	8 5.5%	4	9 6.2%	2	1 0.7%	1
May not be as tasty as naturally ripened fruits.	4 2.8%	10	8 5.5%	10	21 14.5%	16	13 8.9%	7	22 15.2%	9	9 6.2%	3	10 6.9%	1	1 0.7%	1
Do not last long before getting spoilt	8 5.5%	6	12 8.3%	6	28 19.3%	9	14 9.7%	6	27 18.6%	4	10 6.9%	2	10 6.9%	1	2 1.4%	0

The table shows that consumers aged 35 to 41 years had the highest detection ability (13.1%) in recognizing that fruits ripened with calcium carbide develop dots and patches on their surface after a few days, followed by those aged 49 to 55 years (9.6%). Similarly, the ability to detect that fruits ripened with calcium carbide may appear ripe and attractive on the outside while remaining green and raw inside was highest among consumers aged 49 to 55 years (16.6%), followed by those aged 35 to 41 years (13.8%). Consumers aged 49 to 55 years also had a greater ability (15.2%) to detect that fruits ripened with calcium carbide may not be as tasty as naturally ripened ones, followed closely by those aged 35 to 41 years (14.5%). Regarding the ability to detect that fruits ripened with calcium carbide spoil more quickly than naturally ripened ones, participants aged 35 to 41 years had a slightly higher detection capacity (19.3%) compared to those aged 49 to 55 years (18.6%). The table indicates that age influences consumers' ability to detect fruits ripened with calcium carbide. Overall, it reveals that households within the 35 to 41 age range demonstrate the highest detection ability.

Discussions

The findings of this study indicate that consumers have a moderate awareness of the risks associated with consuming fruits ripened with calcium carbide. This contrasts with the study conducted by Orok et al. (2024), in which participants demonstrated a limited understanding (24.6%) of the health hazards linked to consuming such fruits. Their study also reported that consumers identified cancer, abdominal burns, and diarrhea as some of the associated health risks of consuming calcium carbide-ripened fruits. Additionally, this study reveals that consumers in urban communities have a greater awareness of these health risks compared to those in rural areas. This finding aligns with the report by Kumar and Singh (2022), which documented that urban residents are more frequently exposed to health information and food safety regulations, leading to a higher awareness of the risks associated with calcium carbide-ripened fruits.

Furthermore, the study demonstrates that urban consumers are more adept at detecting fruits ripened with calcium carbide than their rural counterparts. This finding is consistent with the report by Kumar and Singh (2022), which indicated that urban residents, due to their increased exposure to health information and regulations, exhibit a higher awareness of food safety risks. Thus, geographical location plays a significant role in consumers' ability to identify artificially ripened fruits. The study also reveals that households with tertiary education levels have a greater awareness of the health risks associated with consuming fruits ripened with calcium carbide compared to those with lower educational levels. This finding aligns with the study by Mu'azu, Muhammad, Abdullahi, and Dodo (2024), which found that fruit sellers with higher educational backgrounds possessed greater knowledge of the health effects of calcium carbide application on fruits.

Similarly, the findings indicate that households with tertiary education levels have a better ability to detect fruits ripened with calcium carbide than those with lower education levels. This is also consistent with the study by Mu'azu et al. (2024), which reported that fruit sellers with higher educational backgrounds had greater awareness of the health risks associated with calcium carbide use. Moreover, the study highlights that households within the age range of 35 to 41 years exhibit a greater awareness of the health effects of consuming calcium carbide-ripened fruits. This finding aligns with Kumar and Singh (2022), who revealed that younger consumers tend to be more informed about the dangers of chemically ripened fruits due to better access to information through technology and education compared to older generations. However, this finding contradicts that of Mu'azu et al. (2024), who found that age had an insignificant influence on fruit sellers' knowledge of the health risks associated with calcium carbide in Jigawa State.

Finally, the findings indicate that households within the 35 to 41 age range also demonstrate the highest ability to detect fruits ripened with calcium carbide. This is consistent with the findings of Kumar and Singh (2022), who reported that younger consumers are generally more knowledgeable about the dangers of chemically ripened fruits due to greater access to information through digital platforms and educational resources.

Conclusion

Household consumers in urban communities demonstrated greater awareness of the health effects of calcium carbide-ripened fruit, as well as a stronger ability to detect such fruit, compared to those in rural communities. Similarly, households with tertiary education exhibited higher awareness and detection skills than those with lower educational levels. Additionally, middle-aged households showed greater awareness and detection capability than older age groups.

Recommendations

Based on the results of this study the following were recommended:

- There is a need to increase awareness campaigns for households about the dangers of consuming fruits ripened with calcium carbide. This can be achieved through radio and television programs, as well as other communication channels and community outreach initiatives that educate consumers about the associated health risks.
- Special emphasis should be placed on rural communities, where literacy levels may be lower, by using local languages to ensure better understanding.
- Similarly, laws should be enacted to prohibit the use of calcium carbide for fruit ripening.
- Farmers and fruit sellers should also be encouraged to adopt safer alternatives or natural ripening methods.

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References

Adeyemi,M.M, Bawa, M. H., & Muktar. B. (2018). Evaluation of the Effect of Calcium Carbide on Induce Ripening of Banana, Pawpaw and Mango cultivated within Kaduna Metropolis, Nigeria" J. Chem Soc. Nigeria, 43 (2), 108 -118.

Akinmoladun, O. M., Omololu, A. O., &Akinmoladun, A. F. (2020). *Health risks of consuming calcium carbide-ripened fruits: A review*. Journal of Food Safety and Hygiene, 38(2), 101-108.

Bolarinwa, I. F., Ajayi, O. O., & Alabi, A. O. (2021). *Consumer knowledge and perception of artificial ripening of fruits with calcium carbide in Nigeria*. Journal of Consumer Protection and Food Safety, 44(5), 56-64.

Bature (2018). How mango, banana, plantain cause terminal illnesses-investigation. Daily Trust (Sunday, June 03, 2018). https://www.dailytrust.com.ng/how-mango-banana-plantain-cause-terminal-illnesses-investigation.html

Chandel, R. (2014). Development of a Method for Safe Ripening and Removal of Calcium carbide Residues inTtraditionally Ripened Mango fruits. Ph.D theses Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan India

Gandhi1, S, Sharma, M., & Bhatnagar, B. (2016). Comparative Study on the Ripening Ability of Banana by Artificial Ripening Agent (Calcium Carbide) and Natural Ripening Agents. Indian Journal of Nutrition, 3 (1), Retrieved from www.opensciencepublications.com

Gupta, R. (2017). Artificial Ripening of Fruits and Effects on Health. *International Conference on Recent trends in Engineering, Science and Management*. Retrieved from www,conferenceworld.in

Hossain, M. F., Akhtar, S. & Anwar, M. (2015). Health hazards posed by the consumption of artificially ripened fruits in Bangladesh . International Food Research Journal 22(5), 1755-1760. http://www.ifrj.upm.edu.my

Ismail, N.S., Rasdi, I., Mangala, P.S., &Adidin. E. Z. (2017). Respiratory symptoms and Sociodemographic factors among Agricultural Workers exposed to Calcium carbide as Fruits Ripening agent in Kuala Kangsar, Perak: a Preliminary Study 2017. *Annals of Tropical Medicine and Public Health, 10 (2)*, 432- 35. Retrieved from http://www.atmph.org/article.asp?issn=1755-6783;year=2017;volume=10;issue=2;spage=432;epage=435;aulast=Ismail

Islam, M.N.,Mursalat, M.,& Khan, M.S. (2016). A Review on the Legislative Aspect of Artificial Fruit Ripening *Agriculture & Food Security, 5(8),1-10.*

Kumar, R., & Singh, R. (2022). Consumer awareness of the health effects of calcium carbide-ripened fruits in rural and urban Indi*a*. International Journal of Food Science and Nutrition, 73(4), 22-30.

Mu,azu, K., Muhaaamad, U. Abdullahi, U. & Dodo, H. (2024). Knowledge of the Health effects of Calcium Carbide Application on Fruits for Human Consumption among Fruit sellers in Jigawa State. *African Journal of Environment and Sustainable Development*, 2(2),18-27. DOI:10.5261/zenodo.11162267

Lawaly, M. M. (2022). Effects of Calcium Carbide Used as a Fruit-Ripening Agent on Fruit Toxicity. *European Journal of Nutrition & Food Safety* 14 (10), 64-76.

Mahmood, T., Saeed, I., Anwer, H., & Mahmood, I. (2013). Comparative Study to Evaluate the Effect of Calcium carbide (cac2) as an Artificial Ripening Agent on shelf life, physio-chemical properties, iron containment and quality of *prunus persica l. Batsch.* European Academic Research, 1 (5), 2286-4822 . Retrieved from www.euacademic.org

Mazo, R. S. (2015). The impact of the presence on global markets of calcium carbide originating from china on other industry role players: the case of sa calcium carbide (pty) ltd. *Masters' thesis University of Kwazulu-Natal*

Orok, E., Okeke, U., Williams, T. et al. (2024). Survey of knowledge on calcium carbide use in fruit ripening and associated health risks among fruit sellers and consumers in Ado-Ekiti Nigeria. *Discovery Public Health* **21**, 28. https://doi.org/10.1186/s12982-024-00149-2

Osakue, J.O. &Okungbowa, M.A.O . (2018). Calcium Carbide Ripened *Musa sapientum*-Induced Reduction in White Blood Cell Count in Challenged Albino Wistar Rats.*Tropical Journal of Natural Product Research*, 2(3), 114-117.https:// www.tjnpr.org

Ogbuagu1, D.H., Ujowundu2, C.O., &Izunobi L.C. (2016). Calcium Carbide Induced Haematological Alterationsin the Albino Mice- Mus musculus.*Journal of Environmental Science, Toxicology and Food Technology*, 10 (10), 100-104 Retrieved from www.iosrjournals.org

Orok, E., Okeke, U.,Williams,T., Adeniyi, F., Ikpe, F., & Femi-Oyewo (2024). Survey of Knowledge on Calcium carbide use in Fruit ripening and Associated health risks among fruit sellersand consumers in Ado-Ekiti Nigeria. *Discover Public Health.* 21- 28. https://doi.org/10.1186/s12982-024-00149-2

Sharma, R., & Sharma, S. (2021). Calcium carbide-induced ripening of fruits: An analysis of health risks and consumer awareness in urban and rural populations. Journal of Environmental Health and Sustainable Development, 5(1), 13-22

Sharma, B.M, Manan, J. & Kaur, A. (2017). Effect of Fruit Ripening Agents on Composition and Storage Quality of Muskmelon. *International Journal of Current Microbiology and Applied Sciences*,6 (9), 2012-2018. Retrieved from http://www.ijcmas.com

Shaon, S. M., Zaman, P., Neaz, 1, S. M., Shanzana, P., Rajib. R.I., Rahman, T. Islam, A. et al. (2016). Detection of many Health Hazardous Chemicals Used in Tomato Marketing in Bangladesh. *British Biotechnology Journal* 15(2): 1-12. Retrieved from www.sciencedomain.org